Injuries and Socioeconomic Status in Iganga and Mayuge, Uganda: Inequities, Consequences and Impacts

by
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Abstract

Injuries pose a major threat to international public health, as they have led to the deaths of over 4.8 million people in 2013, accounting for nearly ten percent of global mortality, and to the loss of 276 million disability-adjusted life years (DALYs), which was 11% of all DALYs lost around the world. Despite the magnitude of this disease burden, evidence on the relationship between injuries and socioeconomic status (SES) in sub-Saharan Africa has been limited to date. To explore the socioeconomic disparities and consequences of injuries in rural Uganda, this study utilized population-based data from the Iganga-Mayuge Demographic Surveillance Site (IM-DSS) in eastern Uganda and injury surveillance data from the Johns Hopkins University International Injury Research Unit (JH-IIRU), as well as conducted a follow-up of individuals who reported an injury and implemented a household-based survey.

The first paper is entitled "*Socioeconomic Status and Injuries in Uganda: Disparities in a Demographic Surveillance Site.*" This paper presents the socioeconomic disparities in injury occurrence with a specific focus on sex of the injured, sex of the household head and household wealth. The second paper is entitled "*Direct Socioeconomic Consequences of Injuries in a Demographic Surveillance Site.*" This paper examines the direct socioeconomic outcomes occurring as a result of an injury, including the loss of time, money, and productivity. The third paper is entitled "*Household Socioeconomic Consequences of Injuries in a Demographic Surveillance Site.*" This paper delves further into the socioeconomic consequences to detect post-injury changes in household socioeconomic outcomes, including income, food production, and food consumption, and to identify and describe the employment of coping strategies.

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Table of Contents

List of Tables

Overview

Paper One

Paper Two

Paper Three

List of Figures

Overview

Paper One

Paper Two

Paper Three

Glossary of Acronyms

DALY	Disabiltiy adjusted life year
DHS	Demographic and Health Survey
DSS	Demographic Surveillance Site/System
GBD	Global Burden of Disease
GDP	Gross Domestic Product
GNI	Gross National Income
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immuno-Deficiency Symdrome
IM-DSS	Iganga-Mayuge Demographic Surveillance Site
INDEPTH	Continuous Demographic Evaluation of Populations and Their Health
JHU-IIRU	Johns Hopkins University International Injury Research Unit
LMIC	Low- and Middle-Income Countries
MOH	Ministry of Health
MNLM	Multinomial logit model
MUSPH	Makerere University School of Public Health
NGO	Non-governmental organization
PCA	Principal components analysis
RTI	Road traffic injury
SES	Socioeconomic Status
USD	United States Dollar
WHO	World Health Organization

Overview

In 2013, intentional and unintentional injuries had led to the deaths of over 4.8 million people, accounting for nearly ten percent of global mortality.[1] Injuries contributed to 276 million disability-adjusted life years (DALYs), which was 11% of all DALYs lost around the world. A large injury burden lies in sub-Saharan Africa, where injuries contributed to over 7% of all DALYs lost in the region.[2] Between 1980 and 2010, road traffic injury (RTI) death rates increased by 29.8% in the southern region.[3] In western sub-Saharan Africa, this increase was 15.2%, and motorized road transport was the third leading cause of death and one of the top five risk factors for loss of DALYs in 2010.

Despite the magnitude of this disease burden, evidence on the relationship between injuries and socioeconomic status (SES) in sub-Saharan Africa has been limited to date. What role does SES play in generating injury disparities in countries such as Uganda, and what are the socioeconomic consequences experienced by the injured and their households? Achieving a deeper understanding of these issues will fill a gap in the existing literature on the relationship between SES and injuries and inform policy and planning by identifying population groups vulnerable to injuries and determining ways to protect household welfare in the face of an injury. Such research would also strengthen the argument for injury prevention and treatment by demonstrating that they can keep millions around the world not only safe from injuries but also free to achieve and ensure their social and economic well-being.

Statement of Purpose

The overall goal of this proposed research is to explore and describe the relationship between injuries and socioeconomic status in the districts of Iganga and Mayuge in Uganda. The following specific objectives were developed to achieve the goal stated above:

Objective 1: To measure the socioeconomic disparities in injury occurrence in the Iganga and Mayuge districts of Uganda

Objective 2: To describe the direct socioeconomic outcomes occurring as a result of an injury.

Objective 3: To detect the changes in household socioeconomic outcomes as a result of an injury experienced by one of its members and to describe coping strategies employed by the household.

To our knowledge, this is the first study on the socioeconomic disparities of injuries in Uganda and on the measurement of the socioeconomic consequences of injuries in Uganda.

Literature Review

This literature review will begin by defining injuries, socioeconomic status, and socioeconomic consequences of injuries. Relevant findings from existing studies will also be presented. Finally, the review will highlight the gaps in literature.

Injuries

The commonly cited definition of injuries is physical damage to a human being resulting from an acute transfer of mechanical, thermal, electrical, chemical or radiation energy or a sudden absence of heat or oxygen.[4,5] Unintentional injuries are those without pre-determined intent of harm, and examples include injuries caused by road traffic crashes, burns, falls, poisoning, drowning, and occupational and sports injuries. Intentional injuries result from a violent act or "the intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community, that either results in or has a high likelihood of resulting in injury, death, psychological harm, maldevelopment or deprivation."[5]

The causal pathway to injuries has frequently been described through conceptual model developed by William Haddon.[6,7] This framework can be used to understand the relationship between micro- and macro-level causes of injury and the temporal phases of injury, including the period before the event, the event itself and the period after the event. For example, the matrix has been used to identify factors that increase the risk of fatal pesticide self-poisoning in Sri Lanka (Table 1).[8]

Injuries afflict millions of people, and strong evidence for the magnitude of this burden calls for attention and action from policy makers, major donors, and academics. In 2013, intentional and unintentional injuries have led to the deaths of over 4.8 million people, accounting for nearly ten percent of global mortality.[1] The 2013 Global Burden of Disease study also found that injuries contributed to 276 million disability-adjusted life years (DALYs), which was 11% of all DALYs lost around the world. A large injury burden lies in sub-Saharan Africa, as injuries contribute to over 7% of all DALYs lost in the region in 2013.[2]

Between 1980 and 2010, road traffic injury (RTI) death rates in western and southern sub-Saharan Africa increased by 15.2% and 29.8%, respectively.[3] In western sub-Saharan Africa, motorized road transport was the third leading cause of death and one of the top five risk factors for loss of DALYs in 2010.

Socioeconomic Status

The roots of the term socioeconomic status (SES) can be traced back to the concepts of social class and conflict theory, as developed by pivotal social scientists including Marx.[9] This perspective understands society as being defined by class struggle and economic arrangements of domination and submission where one small segment owns the means of production. Membership within a social class structure defines one's identity, standing position in society and experience. In 1883, American sociologist Lester Ward determined an individual's status as a combination of social and economic positions, coining the term "socioeconomic."[10] In the 1980s, SES had been defined as "the relative position of a family or individual on a hierarchical social structure, based on their access to or control over wealth, prestige, and power" and "a composite measure that typically incorporates economic status, measured by income; social status, measured by education; and work status, measured by occupation."[11] Two decades later, it was defined as "a broad concept that refers to the placement of persons, families, households, and census tracts or other aggregates with respect to the capacity to create or consume goods that are valued in our society."[12] SES has also been understood through Sen's capability approach which evaluates human welfare in terms of freedom, opportunity and ability to develop one's potential.[13]

Given this variation in definitions of SES, it is to no surprise that the process of measuring and analyzing SES has been open to interpretation and considerable debate.[14-17] A number of studies have identified strengths and weakness in potential measures of SES. The measurement of income has limitations in both accuracy and measurement. Consumption-based measures have proven to be useful,[18] as these measures solve the problematic seasonality of income. However, they do not measure the value of the bartered good and usually fail to measure work carried out by individuals for their own benefit, such as house improvement. Measuring assets has its weaknesses, as this measure lacks the cardinality and fungibility of a monetary measure such as income, and assigning weights can be difficult, especially for those that represent human or social capital. But asset measurement has proven to provide great benefits in complementing income and consumption-based measures of welfare and wealth, as it has a lower likelihood of recall or measurement problems, and some argue that it provides a better picture of long-term living standards than income.[19,20] Finally, some studies have employed mixed methods, such as the combination of qualitative, participatory, and quantitative approach, to assess poverty and wealth.[21,22] In sum, "one size does not fit all," and researchers need to consider measures that are plausibly relevant to population of interest, the outcome, and the likely causal pathways.[23,24]

The relationship between SES and population health is one that requires careful examination, and this includes the role that SES plays in generating injury disparities.[25] First, sex differences in global injuries are conspicuous. The average burden per 100,000 female population in 2013 was 2,150 disability-adjusted life years (DALY), but among the male population, the loss of health was 4,740 DALYs (Table 2). In sub-Saharan Africa, the difference in DALY rates by sex is even wider (2,904 vs. 5,613 DALYs per 100,000 population). The 2013 Global Burden of Disease (GBD) research also estimated the percentage of total DALYs lost to specific injury causes such as road traffic injuries (RTIs), interpersonal violence, self harm, and drowning by sex. These estimates were about two to three times as large among males than females, again demonstrating that injuries are a larger health concern among men.

Educational attainment is the second factor of interest, and its relationship with injuries in LMICs is more nuanced and varied (Table 3). Higher levels of educational attainment have been found to both increase and decrease the risk of interpersonal violence[26-28] and self harm,[29-31] decrease the risk of pedestrian RTIs and RTIs resulting in disability,[32,33] and increase the risk of childhood burns.[34] In Sudan, having a mother who attained higher levels of education increased the risk of non-transport mechanical injuries and of animal bites leading to hospitalization, but it decreased the risk of poison injuries.[35] In Ghana, no association between the mother's education and childhood burn injuries was detected.[36]

Third, material wealth appears to have an inverse relationship with injury incidence (Table 4). A number of studies, many of which were included in a literature review conducted and updated by Laflamme et al,[25,37] found that higher levels of household wealth provided protection against childhood injuries of all causes in Bangladesh,[38] childhood burns in South Africa,[39] RTIs resulting in disability in China,[33] and interpersonal violence for all ages in South Africa[40] and Sudan.[35] However, the opposite direction for this relationship has also been observed in South Africa and Sudan, as higher asset index scores increased the risk of all-cause injury mortality and belonging in a higher wealth tertile increased the risk of an RTI.[35,41]

Socioeconomic Consequences of Injury

Another vital aspect of the relationship between health and SES is the set of socioeconomic consequences faced by households with a member that suffered a health event such as an injury. An excellent way to understand this relationship is through a framework for household utility, or the benefit or satisfaction derived from the consumption of good and services.[42] Bardhan and Udry proposed that the function of a household's endeavor to maximize utility (U) depends on leisure time (L), consumption of home-produced goods (C), and consumption of market goods (M):

$$U = U (L, C, M)$$

Each of these components is subject to constraints, such as the need for household labor, land, and other inputs in order to produce home-consumed goods. Household labor on the open wage market, the net value of crops sold, cash outlays, and non-labor income are all constraints for the purchase of market goods. And finally, leisure is subject to the amount of time available to the household which divides its time between leisure and production.

An injury can have an impact on this household utility function through the mediators of L, C, and M, as illustrated by the *WHO Guide To Identifying the Economic Consequences of Disease and Injury*.[43] First, one's health status (H) may reduce a household's amount of available time including the L component of the function. Second, an injury directly impacts U in that individuals derive utility from being healthy. Finally, given the preference not to incur the expenses of health goods and services in monetary terms nor in terms of time, the consumption of health goods and services do not directly yield economic welfare. The consumption of market goods (M) is then reduced to the consumption of non-health market goods (M_n). The new equation is now as follows:

$$U = U(L, C, M_n, H)$$

A number of studies have explored the economic burden of injuries on the injured and their families, confirming that injuries do threaten household utility, and some have estimating the loss in monetary terms.[44-49] In sub-Saharan Africa, a population-based survey conducted in Nigeria found that among those who experienced an RTI, 17% lost their jobs and 89% experienced a reduction in earnings (Table 5).[50] In Ghana, after an individual experienced a blunt, penetrating, or burn injury in Ghana, his or her household reported a decline in food consumption.[51] More than a quarter of all Vietnamese households with a member who received in-patient hospital-based care for his or her injury spent more than 40% of its capacity to pay for medical treatment,[46] a threshold that has been used to define "catastrophic expenditure."[52]

To determine how best to protect vulnerable households and mitigate such socioeconomic consequences, one must understand the coping actions of a household when faced with an injury. The concept that households employ coping strategies has been explored in the context of food scarcity and famine in South Asia decades ago,[53,54] and in that context, coping had been defined as a "short-term response to an immediate and inhabitual decline in access to food."[55] The term "coping" has also been applied to illnesses in sub-Saharan Africa,[56-58] particularly HIV/AIDS.[59-61] For example, household-level responses to an illness aim focused on the management and minimizations of "costs of an event or process that threatens the welfare of one or more members of the household."[59] Following an injury, households in Ghana re-allocated intra-family labor,[51] borrowed money, and sold belongings, but outside of that one study, household coping responses to an injury remain largely unexplored. These households also reported the employment of financial coping strategies such as intra-family labor allocation, money borrowing, and the selling of belongings.

Gaps in literature

Given this overview of scholarly work on the socioeconomic disparities and consequences of injury, some gaps in the literature merit attention and make the case for further research. First, many of the studies were limited to one specific injury cause, most frequently violence or RTIs, and very few studies covered injuries of all causes. Second, very few studies have examined the relationship between injuries of all causes and socioeconomic status in terms of disparities and/or consequences in sub-Saharan Africa, and to our knowledge, none have been conducted in Uganda. Third, while previous work has estimated the household economic burden of an injury, additional work must explore if these outcomes are associated with sociodemographic and injury-related characteristics. Finally, there is a dearth of research that can provide a clear picture on a rural household's preferences for and assessment of coping strategies employed to mitigate the injury's household impact. In order to advance the field of injury treatment and prevention in LMICs, more studies need to be conducted on these topics and relationships.

Study Context

Country profile

Uganda is a landlocked East African country of over 37 million people (Table 6).[62] The British rule of Uganda began in the late 1800s, and in 1962, the country gained its independence.[63] The official languages are English and Swahili, but Luganda is widely spoken across the country. Its gross national income (GNI) per capital (PPP international $) was 1,740 in 2014, and 33% of the population was living on less than $1.90 (2011 PPP international) a day. The distribution of wealth among individuals or households within an economy can be measured through the Gini index, so that a coefficient of 100 corresponds with maximum inequality, and the World Bank's estimate of Uganda's Gini index is 42.4. The literacy rate among individuals of 15 years of age or above is 70.2.[64]

Population and health information

Female and male life expectancies in Uganda in 2013 were 60 and 58 years, respectively (Table 6).[65] During that same year, the 2013 crude death rate was estimated at 9.9 per 1,000 people). Among the 234 countries for which the World Bank Development Indicators DataBank has estimates on the crude birth rate, Uganda had the seventh highest rate (43.2 per 1,000 people). The 2013 total fertility rate (TFR) was high at 5.9 births per woman, which may explains the large population under the age of 15 years (Figure 1).[66] In less than a few decades, the large youth population will continue to grow and widen the base of the population pyramid.[67] This increase in population growth, particularly among youth, marks a pre-transition stage in the demographic transition.

Health system

In 2013, the health expenditure per capita (current US$) was $59 in Uganda, and the total health expenditure as a percentage of GDP was 9%.[68] The health sector in Uganda includes the government, NGOs, and private providers. Government health care uses a tiered system to deliver health care, and this network is comprised of the Ministry of Health (MOH), national referral hospitals, regional referral hospitals, general hospitals, health center IV, health center III, health center II, and village health teams (VHTs) (Figure 2).[69] The MOH provides leadership for health service delivery through a system decentralized with districts and health sub-districts, and it is responsible for the delivery of outputs from strategic plans.[70] The district health system includes both public and private general hospitals, health centers, and community health programs. National referral hospitals serve all Ugandans, provide a full range of services including preventive and curative outpatient services, inpatient care, obstetrics and gynecology, laboratory services, surgery, psychiatry, pathology, radiology, and teaching and research. Regional Referral hospitals provide specialized care such as psychiatric care, ear, nose, and throat, radiology, ophthalmology, and high level surgical pediatrics.[71]

Within the 111 districts and the capital city of Kampala, local governments deliver health systems, oversee human resources, and manage financial resources.[72] Each district's headquarters are either a general hospital or a health center IV, a mini-hospital that delivers a basic preventive and curative outpatient services and inpatient care. Then, each district is further organized into health sub-districts where care is delivered through the lower level health facilities. Health center III provides preventive and curative care, maternity care, referrals, and laboratory services for diagnosis of conditions, while health center II provides outpatient care and community outreach services. The frequent first point of contact for Ugandans, particularly those living in rural areas, is the satellite health facility comprised of village health teams or community medicine distributors. These teams function as a conduit between health facilities and the community. Two out of five village health team members are responsible for preventing, diagnosing and treating childhood malaria, pneumonia, diarrhea, and other common conditions.[69]

The private sector contributes about 50% of health service delivery outlets and includes private not-for-profit organizations (PNFPs), private for-profit health care providers (PFPs), and traditional medicine practitioners.[73,74] Within the private not-for-profit sub-sector, nearly 70% of the organizations fall under the umbrella organization of the Uganda Catholic Medical Bureau and the Uganda Protestant Medical Bureau, while five percent is represented by the Uganda Orthodox Medical Bureau and the Uganda Muslim Medical Bureau. Over 40% of hospitals and 22% of lower level facilities in Uganda are facility-based PNFPs.

Burden of Injuries

In 2013, injuries led to over 26,000 deaths in Uganda (nine percent of all deaths in the country) and over 1.7 million lost DALYs (eight percent of all DALYs).[2,75] Leading causes of injury were RTIs, interpersonal violence, and drowning, and their age-standardized DALY rates were 2331, 640, and 268 per 100,000, respectively. The only research conducted on the social patterning of injuries in Uganda was a case-control study on self-harm in Kampala. The authors found that the male to female ratio among cases was 1.7:1 and that DSH was associated with higher educational attainment, higher SES, and poor housing.[76]

Iganga-Mayuge Demographic Surveillance Site

The Iganga-Mayuge Demographic Surveillance Site (IM-DSS) was established in partnership with Makerere University in 2005 with the goal of generating information to support evidence-based decisions and policy making in the Iganga and Mayuge districts but also at a national level. A Demographic Surveillance System is a population-based site that tracks demographic events and monitors health in a geographically defined population over time.[77] The IM-DSS is based in a predominantly rural region in eastern Uganda, about 120 km east of the capital Kampala (Figure 3). The site follows over 64,000 individuals from approximately 65 villages and 13,000 households, and an estimated one-fifth of the site population lives in the peri-urban area around the town of Iganga.[78,79]

In 2008, the Johns Hopkins University International Injury Research Unit (JH-IIRU) collaborated with the IM-DSS to explore innovative approaches to screen for disability and to characterize it through an in-depth disability and injury assessment module that was designed to be incorporated into regular IM-DSS data collection.[80,81] The injury component of this survey asked the head of each household (or the senior most member of the household present at the time of the interview) if any member of the household had an injury in the last four months. Injuries were defined as that which prevented "the victim from carrying out his or her normal daily activities for at least one day or for which [the household] paid for any treatment." The four-month period was chosen because the IM-DSS collects data once every four months. The first data collection took place during February—April 2009, the second round took place during March—May 2010, and the third took place in January—February 2011.

Conceptual Framework

A conceptual framework guided this study's design and analysis, and it is based on the literature review conducted for this proposal and three existing conceptual frameworks. First, to explain the patterning of disease and death, Link and Phelan developed the fundamental cause theory to highlight the dynamic process through which social conditions such as sex, ethnicity education, and income affect health. When effective interventions or preventative measures become available to a population, those who have greater access to wealth, power, prestige, and beneficial social networks confer the health advantage to protect or treat themselves. This framework thus compels one to examine how social conditions shape risk factors for illness and death. World Health Organization's Commission on Social Determinants of Health developed a similar framework to explain health equity, and this framework categorized risk factors into biological factors, behaviors, material conditions, and psychosocial factors.[82]

While the determinants of health are strongly sociological by nature, the distribution of health and well-being, in turn, influences social hierarchy. This process is captured by the second framework of interest to this study: the Financial and Economic Impacts of Disease or Injury on Households (Figure 4) by the *WHO Guide To Identifying the Economic Consequences of Disease and Injury*.[43] An ill health event can impede a household's ability to achieve the three utility objectives of maximizing leisure time, consumption of home-produced goods, and consumption of non-health market goods. The household may suffer losses in paid or unpaid production, increase consumption of services and goods related to the care required for the ill health event, and decrease consumption of non-health goods and services such as food and clothing.

A third framework similarly explores the aftermath of an illness including its costs and financial impacts, but it also presents the decisions that households make to sustain economic viability (Figure 5).[59] The first three boxes of Russell's framework resemble the information presented in second framework (Figure 4) in that an illness leads to a number of direct and indirect costs which again include expenditures related to seeking treatment or loss of productive labor time. By providing a separate box for coping methods such as borrowing, this framework gives more weight to the selection and employment of coping strategies as a step in the process of how health impacts household livelihood.

Drawing from these three frameworks, this study will follow a framework describing the socioeconomic disparities of injury and the individual's and household's socioeconomic consequences (Figure 6). Indicators of education, occupation, income or assets, and gender influence the latent construct of socioeconomic status, as shown at the top of the framework. Socioeconomic status can effect one's nutritional status, access to a safe transport system, trigger psychological stress, or determine one's access to education on injury prevention. Injury risk factors may include choosing not to wear a motorcycle helmet, having frail bone structure, working in an area that has poorly constructed roads, and feeling psychological stress on the day of the injury. The availability of quality health care also shapes incidence and outcome of an injury.

Finally, an incident injury will lead to a combination of morbidity, disability, and/or death, an outcome that will depend on the individual's interaction with the health care system. The household with an injured member may suffer the various market and non-market related economic consequences, including a decline in paid and unpaid production, a decrease consumption of non-health goods and services and assets, and increases in health goods and services. In response to these adverse outcomes, a household will decide how to cope with the injury financially, such as selling assets or animal stock, relying on savings, or drawing from the existing social capital. All of these events ultimately contribute to an injury's socioeconomic impact on a household, which, in turn, feeds back into household socioeconomic status.

Research Methods

This study used a multiple cross-sectional design combined with a retrospective follow-up design. To fulfill the first objective, four sources of data, as described in Chapter 2, were utilized: three sources of IM-DSS data and JH-IIRU injury assessment data. The sample for this study is the entire population living in the IM-DSS during the two data collection rounds and the major outcome of interest is whether or not an individual experienced an injury of any cause in the last four months. Independent variables related to socioeconomic status included sex of the injured, sex of the household head and household wealth. Wealth was measured through an asset index using principal components analysis and, for the purpose of comparison, a simple sum of assets. Analyses included the calculation of injury rates and RTI rates, Poisson regression models to estimate the effect of independent variables on these rates, logistic regression models to estimate the odds of an injury, the odds of an RTI, and, among those who experienced an RTI, the odds of being a cyclist or pedestrian rather than riding on a motorized vehicle.

To meet the second and third study objectives, this study again used IM-DSS health and demographic data, socioeconomic data, and village area development data, but the major information of interest required follow-up of individuals who reported an injury according to the JH-IIRU injury surveillance tool. In-depth interviews were conducted to collect information on the type of injury, risk factors and events leading to the injury, health care that was sought and received following the injury, and socioeconomic consequences of the injury. Outcomes related to the second objective include the direct consequences of injury including (1) hours spent traveling to initial care among those who sought care, (2) cost of transport to initial care, (3) cost of initial care, (4) ability to return to one's occupation among those who were employed at the time of the injury, (5) number of work days lost among those who were able to return to the occupation held at the time of the injury, and (6) number of school days missed among those who were students at the time of the injury.

The third objective broadens the perspective to indirect household socioeconomic consequences, examines the decline in household income, food production, and food purchases, and explores household's coping mechanisms in response to the injury. Each of these outcomes related to the two study objectives were regressed on sociodemographic characteristics, including household wealth, and injury characteristics. Regression models were selected based on the nature of the outcome variable and include logit, ordered logit, and multinomial logit.

Organization of the Study

The research that was conducted in the Iganga and Mayuge districts of Uganda with the purpose of fulfilling the three objectives is explored in the subsequent chapters. Chapter 2 presents the socioeconomic disparities in injury occurrence with a specific focus on sex of the injured, sex of the household head and household wealth. Next, Chapter 3 examines the direct socioeconomic outcomes occurring as a result of an injury, including the loss of time, money, and productivity. Chapter 4 delves further into the socioeconomic consequences to detect changes in household socioeconomic outcomes as a result of an injury experienced by one of its members. Outcomes include changes in post-injury household income, food production, and food consumption as well as the employment of coping strategies such as relying on unconditional help from family and friends.

After summarizing the key findings from Chapters 2 through 4, the final chapter discusses how this study can inform national, regional and international health policy and planning as well as highlights areas for future research.

References

1. GBD Mortality, Causes of Death Collaborators. Global, regional, and national age–sex specific all-cause and cause-specific mortality for 240 causes of death, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *The Lancet.*385(9963):117-171.
2. Institute for Health Metrics and Evaluation (IHME). GBD Compare. 2015; http://vizhub.healthdata.org/gbd-compare. . Accessed November 5, 2015.
3. Global Road Safety Facility; The World Bank and Institute for Health Metrics and Evaluation. *Transport for Health: The Global Burden of Disease from Motorized Road Transport.* Sealttle, WA2014.
4. Injury prevention: meeting the challenge. The National Committee for Injury Prevention and Control. *Am J Prev Med.* 1989;5(3 Suppl):1-303.
5. Krug E, Dahlberg L, Mercy J, Zwi A, Lozano R. *World report on violence and health.* Geneva, Switzerland: World Health Organization;2002.
6. Haddon W, Jr. A logical framework for categorizing highway safety phenomena and activity. *J Trauma.* 1972;12(3):193-207.
7. Christoffel T, Gallagher SS. *Injury prevention and public health : practical knowledge, skills, and strategies.* 2nd ed. Sudbury, Mass.: Jones and Bartlett Publishers; 2006.
8. Eddleston M, Buckley NA, Gunnell D, Dawson AH, Konradsen F. Identification of strategies to prevent death after pesticide self-poisoning using a Haddon matrix. *Inj Prev.* 2006;12(5):333-337.
9. Marx K, Engels F, Hobsbawm EJ. *The Communist manifesto : a modern edition.* London ; New York: Verso; 1998.
10. Jones FL, McMillan J. Scoring occupational categories for social research: A review of current practice, with Australian examples. *Work, Employment & Society.* 2001;15(3):539-563.
11. Mueller CW, Parcel TL. Measures of socioeconomic status: Alternatives and recommendations. *Child Development.* 1981:13-30.
12. Miech RA, Hauser RM. Socioeconomic status and health at midlife: a comparison of educational attainment with occupation-based indicators. *Annals of Epidemiology.* 2001;11(2):75-84.
13. Sen A. *Development as freedom.* Oxford ; New York: Oxford University Press; 2001.
14. Muntaner C, Lynch J. Income inequality, social cohesion, and class relations: a critique of Wilkinson's neo-Durkheimian research program. *International journal of health services : planning, administration, evaluation.* 1999;29(1):59-81.
15. Wilkinson RG. Income inequality, social cohesion, and health: clarifying the theory--a reply to Muntaner and Lynch. *International journal of health services : planning, administration, evaluation.* 1999;29(3):525-543.
16. Muntaner C, Lynch J, Smith GD. Social capital, disorganized communities, and the third way: understanding the retreat from structural inequalities in epidemiology and public health. *International journal of health services : planning, administration, evaluation.* 2001;31(2):213-237.

17. Coleman J. Social capital in the creation of human capital. *American Journal of Sociology.* 1988;94 (Suppl.):S95-120.
18. Ravallion M. Poverty comparisons. *Living Standard Measurement Study Working Paper.* 1992;88.
19. Carter M, May J. One Kind of Freedom: Poverty Dynamics in Post-Apartheid South Africa. *World Development.* 2001;29(12):1987-2006.
20. Filmer D, Pritchett LH. Estimating wealth effects without expenditure data--or tears: an application to educational enrollments in states of India. *Demography.* 2001;38(1):115-132.
21. Moser CON. *Confronting Crisis. A Comparative Study of Household Responses to Poverty and Vulnerability in Four Poor Urban Communities. Environmentally Sustainable Development Studies and Monographs Series No. 8.* ERIC; 1996.
22. Moser CON. The asset vulnerability framework: reassessing urban poverty reduction strategies. *World development.* 1998;26(1):1-19.
23. Braveman PA, Cubbin C, Egerter S, et al. Socioeconomic status in health research: one size does not fit all. *Jama.* 2005;294(22):2879-2888.
24. Shavers VL. Measurement of socioeconomic status in health disparities research. *J Natl Med Assoc.* 2007;99(9):1013-1023.
25. Laflamme L, Burrows S, Hasselberg M. *Socioeconomic Differences in Injury Risks: A Review of Findings and A Discussion of Ptoential Countermeasures.* Copenhagen, Denmark: World Health Organization Europe; January 2009.
26. Bates LM, Schuler SR, Islam F, Islam K. Socioeconomic factors and processes associated with domestic violence in rural Bangladesh. *Int Fam Plan Perspect.* 2004;30(4):190-199.
27. Ellsberg MC, Pena R, Herrera A, Liljestrand J, Winkvist A. Wife abuse among women of childbearing age in Nicaragua. *Am J Public Health.* 1999;89(2):241-244.
28. Karaoglu L, Celbis O, Ercan C, et al. Physical, emotional and sexual violence during pregnancy in Malatya, Turkey. *Eur J Public Health.* 2006;16(2):149-156.
29. Burrows S, Laflamme L. Living circumstances of suicide mortality in a South African city: an ecological study of differences across race groups and sexes. *Suicide & life-threatening behavior.* 2005;35(5):592-603.
30. Toros F, Bilgin NG, Sasmaz T, Bugdayci R, Camdeviren H. Suicide attempts and risk factors among children and adolescents. *Yonsei medical journal.* 2004;45(3):367-374.
31. Kinyanda E, Wamala D, Musisi S, Hjelmeland H. Suicide in urban Kampala, Uganda: a preliminary exploration. *African health sciences.* 2011;11(2):219-227.
32. Donroe J, Gilman RH, Brugge D, Mwamburi M, Moore DA. Falls, poisonings, burns, and road traffic injuries in urban Peruvian children and adolescents: a community based study. *Inj Prev.* 2009;15(6):390-396.
33. Lin T, Li N, Du W, Song X, Zheng X. Road traffic disability in China: prevalence and socio-demographic disparities. *Journal of public health.* 2013;35(4):541-547.
34. Delgado J, Ramirez-Cardich ME, Gilman RH, et al. Risk factors for burns in children: crowding, poverty, and poor maternal education. *Inj Prev.* 2002;8(1):38-41.

35. Abdalla S, Sudan Household Health Survey National Management T. Patterns of vulnerability to non-fatal injuries in Sudan: initial evidence from a national cross-sectional survey. *Inj Prev.* 2014;20(5):310-316.
36. Forjuoh SN, Guyer B, Strobino DM, Keyl PM, Diener-West M, Smith GS. Risk factors for childhood burns: a case-control study of Ghanaian children. *Journal of epidemiology and community health.* 1995;49(2):189-193.
37. Laflamme L, Hasselberg M, Burrows S. 20 Years of Research on Socioeconomic Inequality and Children's-Unintentional Injuries Understanding the Cause-Specific Evidence at Hand. *International journal of pediatrics.* 2010.
38. Giashuddin SM, Rahman A, Rahman F, et al. Socioeconomic inequality in child injury in Bangladesh - implication for developing countries. *Int J Equity Health.* 2009;8:7.
39. Niekerk AV, Reimers A, Laflamme L. Area characteristics and determinants of hospitalised childhood burn injury: a study in the city of Cape Town. *Public Health.* 2006;120(2):115-124.
40. Doolan K, Ehrlich R, Myer L. Experience of violence and socioeconomic position in South Africa: a national study. *PloS one.* 2007;2(12):e1290.
41. Garrib A, Herbst AJ, Hosegood V, Newell ML. Injury mortality in rural South Africa 2000-2007: rates and associated factors. *Tropical medicine & international health : TM & IH.* 2011;16(4):439-446.
42. Bardhan P, Udry C. *Development microeconomics.* Oxford University Press, USA; 1999.
43. *WHO Guide to Identifying the Economic Consequences of Disease and Injury.* Gevena, Switzerlind: Department of Health Systems Financing, Health Systems and Services, World Health Organization,;2009.
44. Riewpaiboon A, Piyauthakit P, Chaikledkaew U. Economic burden of road traffic injuries: a micro-costing approach. *Southeast Asian J Trop Med Public Health.* 2008;39(6):1139-1149.
45. Hijar M, Arredondo A, Carrillo C, Solorzano L. Road traffic injuries in an urban area in Mexico. An epidemiological and cost analysis. *Accident; analysis and prevention.* 2004;36(1):37-42.
46. Nguyen H, Ivers R, Jan S, Martiniuk A, Pham C. Catastrophic household costs due to injury in Vietnam. *Injury.* 2012.
47. Joshi SK, Shrestha S. Economic and social burden due to injuries and violence in Nepal: a cross-sectional study. *Kathmandu Univ Med J (KUMJ).* 2009;7(28):344-350.
48. Perez-Nunez R, Hijar-Medina M, Heredia-Pi I, Jones S, Silveira-Rodrigues EM. Economic impact of fatal and nonfatal road traffic injuries in Belize in 2007. *Rev Panam Salud Publica.* 2010;28(5):326-336.
49. Perez-Nunez R, Avila-Burgos L, Hijar-Medina M, Pelcastre-Villafuerte B, Celis A, Salinas-Rodriguez A. Economic impact of fatal and non-fatal road traffic injuries in Guadalajara Metropolitan Area and Jalisco, Mexico. *Inj Prev.* 2011;17(5):297-303.
50. Juillard C, Labinjo M, Kobusingye O, Hyder AA. Socioeconomic impact of road traffic injuries in West Africa: exploratory data from Nigeria. *Inj Prev.* 2010;16(6):389-392.

51. Mock CN, Gloyd S, Adjei S, Acheampong F, Gish O. Economic consequences of injury and resulting family coping strategies in Ghana. *Accident; analysis and prevention.* 2003;35(1):81-90.
52. Xu K, Evans DB, Carrin G, Aguilar-Rivera AM, Musgrove P, Evans T. Protecting households from catastrophic health spending. *Health affairs.* 2007;26(4):972-983.
53. Jodha NS. Effectiveness of farmers' adjustments to risk. *Economic and Political Weekly.* 1978:A38-A48.
54. Drèze J. Famine prevention in India. *WIDER Working Papers (UNU).* 1988.
55. Davies S. Are coping strategies a cop out? *IDS bulletin.* 1993;24(4):60-72.
56. Sauerborn R, Adams A, Hien M. Household strategies to cope with the economic costs of illness. *Social science & medicine.* 1996;43(3):291-301.
57. Jayawardene R. Illness perception: social cost and coping-strategies of malaria cases. *Soc Sci Med.* 1993;37(9):1169-1176.
58. Chima RI, Goodman CA, Mills A. The economic impact of malaria in Africa: a critical review of the evidence. *Health policy.* 2003;63(1):17-36.
59. Russell S. The economic burden of illness for households in developing countries: a review of studies focusing on malaria, tuberculosis, and human immunodeficiency virus/acquired immunodeficiency syndrome. *Am J Trop Med Hyg.* 2004;71(2 suppl):147-155.
60. Mutangadura G, Mukurazita D, Jackson H. A review of household and community responses to the HIV/AIDS epidemic in the rural areas of sub-Saharan Africa. 1999.
61. Rugalema G. Coping or struggling? A journey into the impact of HIV/AIDS in southern Africa. *Review of African Political Economy.* 2000;27(86):537-545.
62. United Nations Population Division. World Population Prospects. 2011.
63. Duignan P, Gann LH. *Colonialism in Africa 1870-1960.* Vol 4: CUP Archive; 1975.
64. World Health Organization. Global Health Observatory Data Repository. http://apps.who.int/ghodata/. Accessed July, 2012.
65. Salomon JA, Vos T, Hogan DR, et al. Common values in assessing health outcomes from disease and injury: disability weights measurement study for the Global Burden of Disease Study 2010. *Lancet.* 2012;380(9859):2129-2143.
66. United States Census Bureau. International Data Base. 2015; http://www.census.gov/population/international/data. Accessed November 10, 2015.
67. U.S. Census Bureau. International Programs. http://www.census.gov/population/international/data/idb/informationGateway.php.
68. Organization WH. Global Health Expenditure Database. 2015; http://apps.who.int/nha/database/Select/Indicators. Accessed November 9, 2015.
69. Uganda Ministry of Health. *The Uganda Malaria Reduction Strategic Plan 2014-2020.* Kampala, Uganda May 2014.
70. Ministry of Health. *Annual Health Sector Performance Report: Financial Year 2011/2012.* Kampala, Uganda: Government of Uganda;2012.

71. Uganda Ministry of Health. *Report on the State of Regional Referral Hospitals in Uganda: Towards the Realization of the Right to Health.* Kampala, Uganda: HURINET-U; May 2012.
72. Republic of Uganda--Ministry of Local Government. List of Local Government Districts. http://www.molg.go.ug/local-governments. Accessed January, 2013.
73. Uganda Ministry of Health, Health Systems 20/20, Makerere University School of Public Health. *Uganda Health System Assessment 2011.* Kampala, Uganda and Bethesda, MD April 2012.
74. Ministry of Health. *Health Sector Strategic Plan III: 2010/11 - 2014/2015.* Kampala, Uganda: Government of Uganda;2010.
75. Global Health Data Exchange: All ages DALYs (thousands) and age-standardised DALY rates (per 100 000) with 95% UI for 306 causes, by country, both sexes combined, in 1990, 2005, and 2013, with median percent change. 2015. http://ghdx.healthdata.org/global-burden-disease-study-2013-gbd-2013-data-downloads. Accessed November 10.
76. Kinyanda E, Hjelmeland H, Musisi S. Deliberate self-harm as seen in Kampala, Uganda - a case-control study. *Social psychiatry and psychiatric epidemiology.* 2004;39(4):318-325.
77. INTERNATIONAL DEVELOPMENT RESEARCH CENTRE. *POPULATION AND HEALTH IN DEVELOPING COUNTRIES: Population, Health, and Survival at INDEPTH Sites, Vol 1.* 2002.
78. Waiswa P, Kallander K, Peterson S, Tomson G, Pariyo GW. Using the three delays model to understand why newborn babies die in eastern Uganda. *Tropical medicine & international health : TM & IH.* 2010;15(8):964-972.
79. Kallander K, Hildenwall H, Waiswa P, Galiwango E, Peterson S, Pariyo G. Delayed care seeking for fatal pneumonia in children aged under five years in Uganda: a case-series study. *Bull World Health Organ.* 2008;86(5):332-338.
80. Bachani AM, Galiwango E, Kadobera D, et al. A new screening instrument for disability in low-income and middle-income settings: application at the Iganga-Mayuge Demographic Surveillance System (IM-DSS), Uganda. *BMJ Open.* 2014;4(12):e005795.
81. Bachani AM, Hyder AA, Kadobera D, et al. Application of a new instrument to measure injuries and disability at the Iganga-Mayuge demographic surveillance system (im-dss), Uganda. *Injury prevention.* 2012;18(Suppl 1):A92-A92.
82. Commission on Social Determinants of Health. *Closing the gap in a generation: health equity through action on the social determinants of health. Final Report of the Commission on Social Determinants of Health.* Geneva: World Health Organization;2008.

Table 1. The Haddon Matrix For Injury: Pesticide Self-Poisoning in Sri Lanka

		Factors		
		Human Factors	**Agent (pesticide)**	**Environment (community)**
Phases	**Pre-event**	Alcohol intoxication Gender, weight, impulsivity Knowledge about lethality of particular pesticides Meal before ingestion	Concentration and quantity of available pesticide formulations	Safe pesticide storage Pesticide bans/restrictions Accessibility of toxic pesticides
	Event	Alcohol intoxication Level of intent	Dose ingested Toxicity of the pesticide Additives affecting absorption/palatability	Proximity to other people during attempt
	Post-event	Help-seeking behavior Health, age Chronic alcohol use and dependence Genetic factors (affecting pesticide metabolism)	Speed of poisoning onset Effectiveness of treatment Availability and affordability of antidotes and ventilators	First aid Help-seeking behavior Access/transport to hospital care Quality/affordability of health care at both 1° and 2° hospital levels

Source: Eddleston M, Buckley NA, Gunnell D, Dawson AH, Konradsen F. Identification of strategies to prevent death after pesticide self-poisoning using a Haddon matrix. *Inj Prev* 2006; **12**(5): 333-7.

Table 2. Disability-adjusted life years (DALYs) for Global Injuries in 2013

Injury Cause	Region	DALY estimate	
		DALYs per 100,000	
All causes	Global	3,828	
	Sub-Saharan Africa	4,258	
		DALYs per 100,000	
		Female	**Male**
All causes	Global	2,150	4,740
	Sub-Saharan Africa	2,904	5,613
		% of total DALYs	
		Females	**Males**
Road traffic injuries	Global	1.6	4.1
	Sub-Saharan Africa	1.8	3.5
Interpersonal violence	Global	0.4	1.3
	Sub-Saharan Africa	0.3	0.8
Self harm	Global	0.4	1.8
	Sub-Saharan Africa	0.3	0.6
Drowning	Global	0.6	1.28
	Sub-Saharan Africa	0.5	0.8

Sources: GBD Mortality, Causes of Death Collaborators. Global, regional, and national age–sex specific all-cause and cause-specific mortality for 240 causes of death, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *The Lancet*; **385**(9963): 117-71; and Institute for Health Metrics and Evaluation (IHME). GBD Compare. 2015. http://vizhub.healthdata.org/gbd-compare. (accessed November 5 2015).

Author and Year	Region	Sample characteristics	Injury	Association between Education and Injury Risk	
				Direction	Description
Abdalla 2013	Sudan	All household members	Non-fatal animal bites, burns, falls, interpersonal violence, mechanical, poisoning, and road traffic injuries	Mixed	Compared to having a mother who did not attain any education, having one who attained a higher level increased risk of mechanical injuries and of animal bites leading to hospitalization, and decreased risk of poisoning
Lin et al. 2013	China	All household members	Road traffic injuries resulting in disability	Negative	Among adults, having at least senior high school education decreased risk
Garrib et al. 2011	South Africa	All household members	Fatal all-cause injuries	Positive	Not having attained education decreased risk
Donroe et al. 2009	Lima, Peru	Younger than 18 years	Non-fatal burns, falls, poisonings, and road traffic injuries	Negative	Having a household head who did not complete high school increased risk of pedestrian RTI
Burrows and LaFlamme 2005	Tshwane, South Africa	15 years and older	Suicide	Mixed	Low levels of "socioeconomic circumstances" (which includes educational attainment as part of the factor analysis) decreased risk for whites, no association for blacks
Karaoglu et al 2005	Malatya, Turkey	Pregnant women	Non-fatal interpersonal violence	Negative	Having a husband who is illiterate or attained less than eight years of education increased risk
Bates et al. 2004	Rural Bangladesh	Married women	Non-fatal interpersonal violence	Negative	Woman having more than five years of education decreases risk
Toros et al. 2004	Mersin, Turkey	6^{th} to 11^{th} grade school children	Self-harm	Negative	Additional year of mother's or father's educational attainment decreased risk
Kinyanda et	Kampala, Uganda	15 years	Self-harm	Positive	Greater educational attainment

al. 2003		and older			increased risk
Delgado et al. 2002	Lima, Peru	Younger than 18 years	Non-fatal burns	Negative	Children who had mothers whose educational attainment was less than high school education completion were at increased risk
Ellsberg et al. 1999	Leon, Nicaragua	15 to 49 year old female	Non-fatal Interpersonal violence	No association	No association for the either the wife's or the husband's educational attainment
Forjuoh et al. 1995	Ashanti region, Ghana	0-5 year old children	Non-fatal burns	No association	No association with whether or not mother attained education

Source: The studies by Delgado et al., Donroe et al., Forjuoh et al., Giashuddin et al., and Van Niekerk et al were reviewed and included in the review article by Laflamme L, Hasselberg M, Burrows S. 20 Years of Research on Socioeconomic Inequality and Children's-Unintentional Injuries Understanding the Cause-Specific Evidence at Hand. *International journal of pediatrics* 2010.

Table 4. Literature on the association between injury risk and household assets as measured by household assets in low- and middle-income countries

Author and Year	Region	Sample characteristics	Injury	Association between Household Assets and Injury Risk	
				Direction	Description
Abdalla 2013	Sudan	All household members	Non-fatal animal bites, burns, falls, interpersonal violence, mechanical, poisoning, RTIs	Mixed	Belonging to a higher wealth tertile increased risk of RTI but decreased risk of interpersonal violence
Doolan et al. 2007	South Africa	All household members	Non-fatal interpersonal violence	Negative	Compared to the poorest quintile, being in the wealthiest decreased risk
Garrib et al. 2011	South Africa	All household members	Fatal all-cause injuries	Positive	Higher asset ownership increased injury mortality
Giashuddin et al. 2009	Bangladesh	1-4 years	Fatal and non-fatal injuries, all causes	Negative	Belonging to a poor household increased risk, especially for drowning
Lin et al. 2013	China	All household members	Road traffic injuries resulting in disability	Negative	Belonging to a household that does not have any electrical appliances increased risk
Van Niekerk et al 2006	Cape Town, South Africa	12 years and younger	Non-fatal, burns	Negative	Falling into the "poor" or "impoverished" housing condition categories increased risk

Source: The studies by Donroe et al., Forjuoh et al., Giashuddin et al., and Van Niekerk et al were reviewed and included in the review article by Laflamme L, Hasselberg M, Burrows S. 20 Years of Research on Socioeconomic Inequality and Children's-Unintentional Injuries Understanding the Cause-Specific Evidence at Hand. *International journal of pediatrics* 2010.

Table 5. Literature on household socioeconomic consequences of injuries in low- and middle-income countries

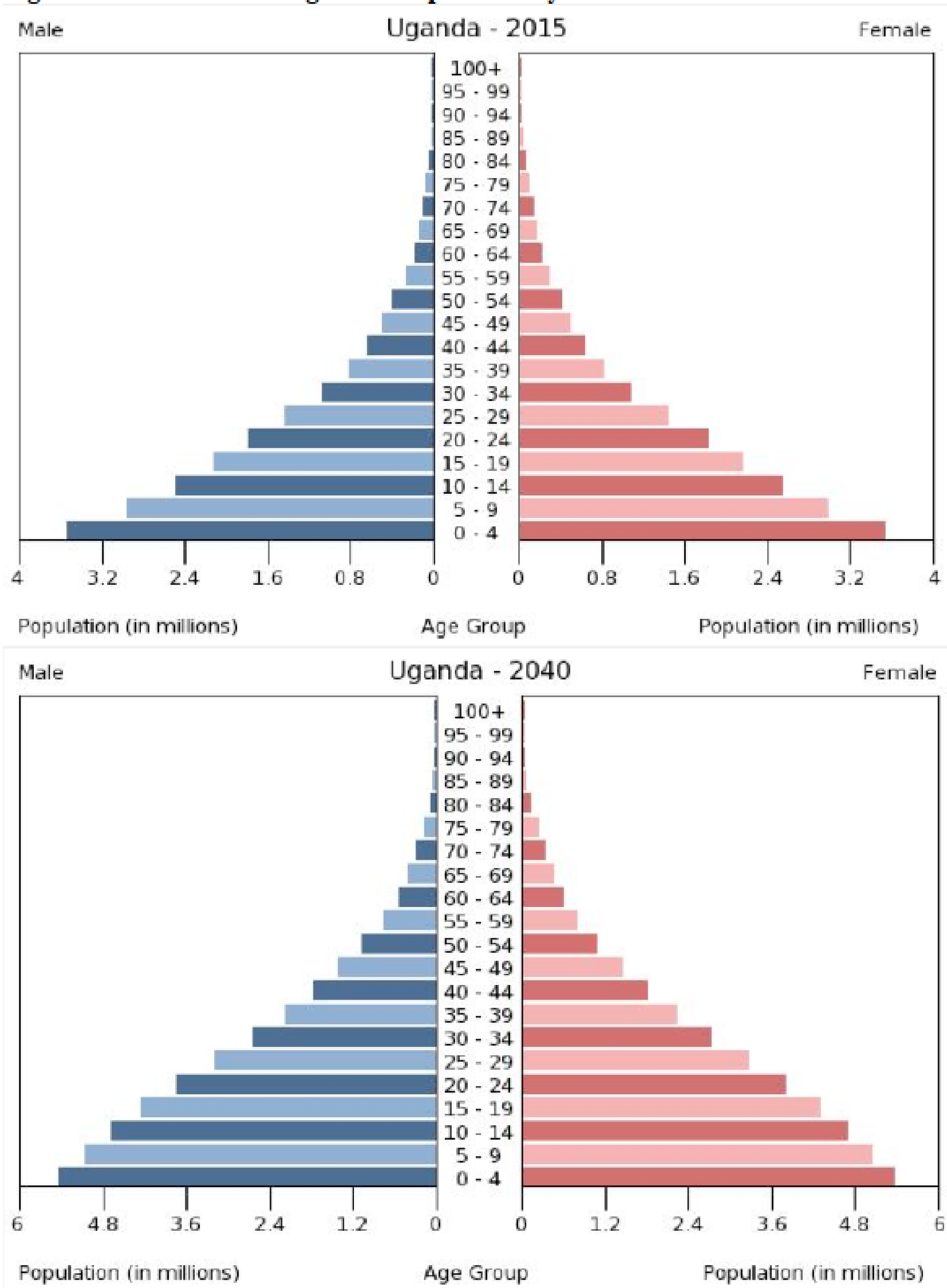
Study	Region	Cause of Injury	Socioeconomic Consequences
Joshi and Shrestha 2009	Urban Nepal	All causes	The cost of a single injury case, when cost is measured as medical expenses and lost work time, was 126 USD.
Juillard et al. 2010	Nigeria, seven states where 40% live in rural areas	Road traffic	• Average cost of formal treatment was 35 USD. • 6 out of 36 employed individuals lost their jobs. • 44% lost between one and seven days of work, 36% lost between one and four weeks of work, and 20% lost over a month of work • 31 out of 35 individuals reported a reduction in earnings as a result of disability
Mock et al. 2003	Ghana, four rural districts	Blunt, penetrating, or burn	• 39% of households reported a loss of income • 33% of households reported a decline in food consumption • 28% of households reported a decline in food production • Household wealth had no effect on household income or food consumption • The most commonly reported coping strategies were intra-family labor reallocation (90%), borrowing money (24%), and sold but did not pawn belongings (2.5%) • Intra-family labor reallocation was utilized by 93% of households located on unpaved roads and 83% of those on paved roads. the chi square test found this relationship significant.
Nguyen et al. 2012	Individuals admitted to Thai Binh General Hospital in Vietnam	All causes	• Average total (direct and indirect) cost of injury was 365 USD • 26% came from households that experienced catastrophic expenditure following an injury. • Risk of catastrophic expenditure was higher among those who had more severe injuries, were of older age, and had a lower income
Riewpaiboon et al. 2008	Patients of a community hospital in central Thailand	Road traffic	The average (direct and indirect) cost per case was 2,596 USD.

Table 6. Demographic and economic indicators of Uganda

Indicator	Estimate	Year
Demographic		
Total population (in thousands)	37,783	2014
Percentage of total population		
Ages 0 to 14	48.3	2014
Urban	15.8	2014
Crude death rate (per 1,000 people)	9.9	2013
Crude birth rate (per 1,000 people)	43.2	2013
Life expectancy at birth (years)		
At birth, total	59.2	2013
At birth, female	60.4	2013
At birth, male	58.0	2013
Total fertility rate (births per woman)	5.9	2013
Contraceptive prevalence (% of women ages 15-49)	30.0	2011
Literacy rate, adult total (% of people ages 15 and above)	70.2	2012
Economic		
GNI per capita (PPP int. $)	1,740	2014
Population living on less than $1.90 (2011 PPP int.) a day (%)	33.2	2012
Gini index	42.4	2012
Health expenditure per capita (current US $)	59.1	2013
Health expenditure as percentage of GDP (%)	9.8	2013

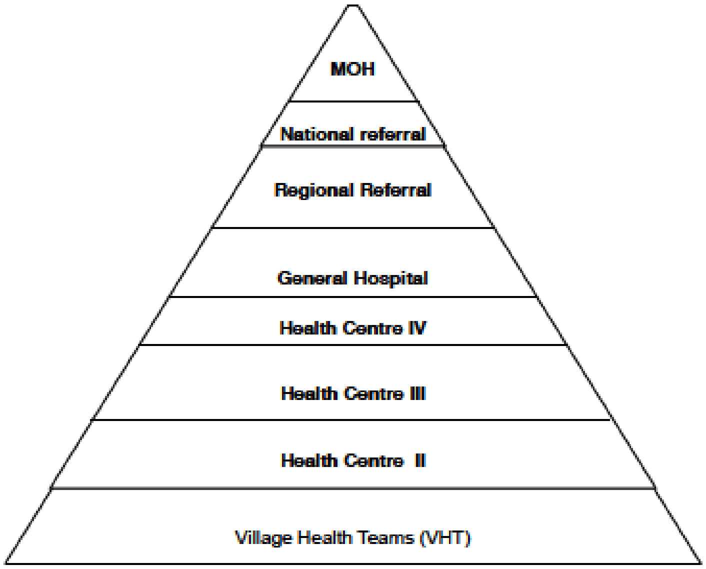
Source: World Bank. World Development Indicators, The World Bank. 2015. http://databank.worldbank.org/data (accessed November 9 2015), , as derived from the following sources (1) United Nations Population Division. World Population Prospects, (2) United Nations Statistical Division. Population and Vital Statistics Report (various years), (3) Census reports and other statistical publications from national statistical offices, (4) Eurostat: Demographic Statistics, (5) Secretariat of the Pacific Community: Statistics and Demography Programme, (6) U.S. Census Bureau: International Database, and (7) World Health Organization Global Health Expenditure database

Figure 1. 2015 and 2040 Ugandan Population Pyramid



Source: United States Census Bureau. International Data Base. 2015. http://www.census.gov/population/international/data (accessed November 10 2015).

Figure 2. Structure of the Ugandan Public Sector Health System

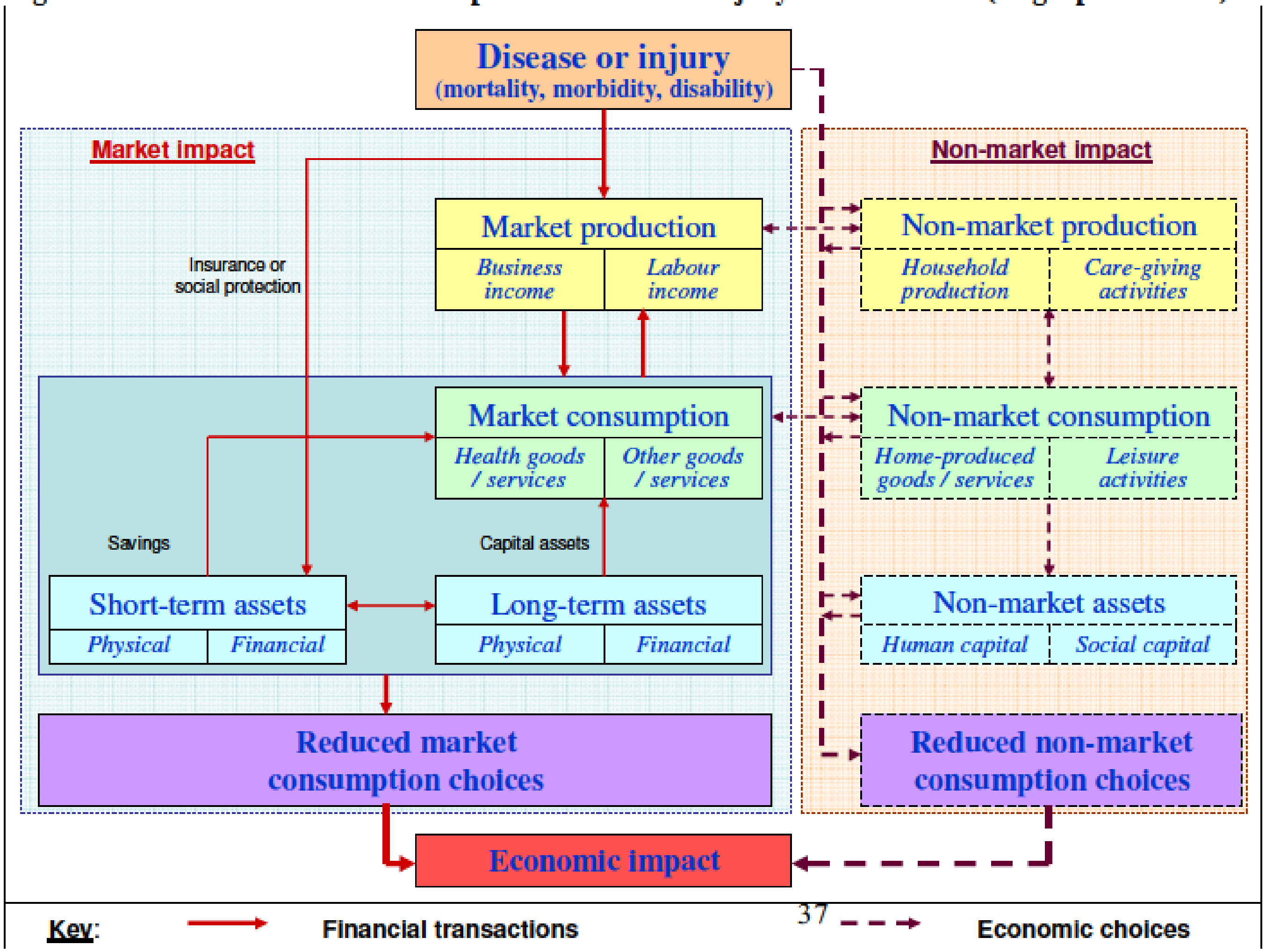


Source: Uganda Ministry of Health. The Uganda Malaria Reduction Strategic Plan 2014-2020. Kampala, Uganda, 2014.

Figure 3. Map of Uganda, showing the Iganga-Mayuge-Demographic Surveillance Site within the Iganga and Mayuge Districts

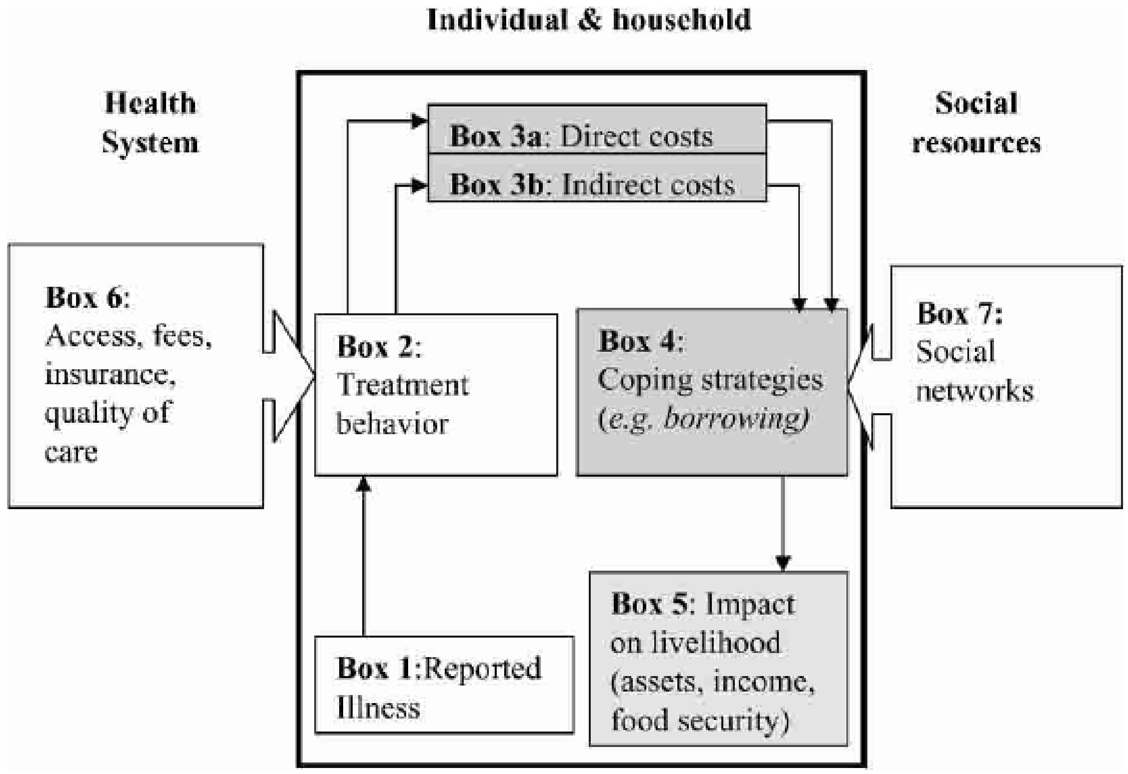
Source: Scribd (http://d.scribd.com/docs/1ir26c0txfte6h45u3jt.pdf)

Figure 4. Financial and economic impacts of disease or injury on households (single period case)



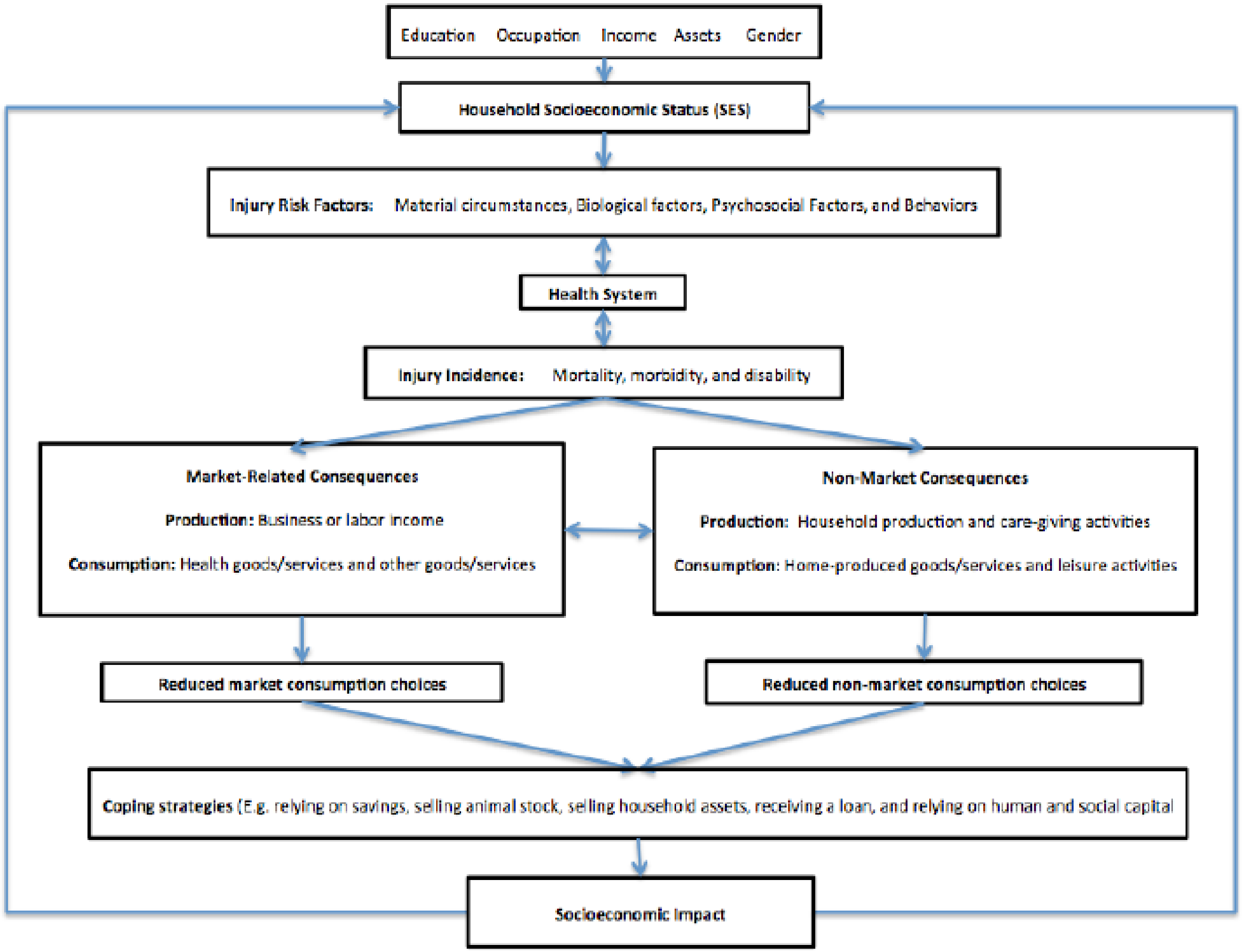
Source: WHO Guide to Identifying the Economic Consequences of Disease and Injury. Gevena, Switzerlind: Department of Health Systems Financing, Health Systems and Services, World Health Organization, 2009.

Figure 5. Conceptual framework for analyzing the economic burden of illness for households



Source: Russell S. The economic burden of illness for households in developing countries: a review of studies focusing on malaria, tuberculosis, and human immunodeficiency virus/acq immunodeficiency syndrome. *Am J Trop Med Hyg* 2004; 71(2 suppl): 147-5

Figure 6. Conceptual Framework For Research



Source: Author

Paper One:

Socioeconomic Status and Injuries in Uganda: Disparities in a Demographic Surveillance Site

Abstract

Injuries pose a major international public health problem, but evidence on the role that socioeconomic status plays in generating injury disparities in sub-Saharan African countries such as Uganda is limited to date. To explore this research question in eastern rural Uganda, a cross-sectional study was conducted using data collected by the Iganga-Mayuge Demographic Surveillance Site (IM-DSS), a population-based site that tracks demographic events and monitors health among those living in the Iganga and Mayuge district. This study also used injury surveillance data collected by the Johns Hopkins University International Injury Research Unit (JH-IIRU) during February—April 2009 and March—May 2010. Among the 59,248 individuals who lived in the site during the two time periods, 54% were female, 28% of the individuals had between 15 and 29 years and 48% were under the age of 15 years. A total of 762 all-causes injuries were reported, 324 of which were road traffic injuries (RTI), resulting in the incidence rates of 20.7 injuries per 1,000 person-years and 8.81 RTIs per 1,000 person-years. Factors that significantly increased the incidence rate ratios and odds ratios include being male, having over 15 years of age, and coming from a household where the head was a female or was a bodaboda or taxi driver. With the exception of the female household head, the same set of significant associations were found in the RTI models, but the impact of being male was greater in magnitude. Among those who had an RTI, older age groups were more significantly likely to be in a motorized vehicle. Household wealth did not have a significant relationship with injuries, RTI, or the type of road user among those with an RTI. Given this situation where having access to wealth and resources offers no protection from injuries and RTIs, one explanation is that effective interventions and

prevention measures are insufficient and have not yet been well implemented. This study yields new information for the purpose of aiding in the development of public health policies, programs, and interventions to meet the needs of individuals at risk of injuries, particularly males, older age groups, and female-headed households. The finding that even the wealthy households were unable to protect themselves from injuries and RTIs, should be alarming to the government and other public health stakeholders and strengthen the argument for injury prevention and treatment.

Introduction

In 2013, intentional and unintentional injuries had led to the deaths of over 4.8 million people, accounting for nearly ten percent of global mortality.[1] Injuries contributed to 276 million disability-adjusted life years (DALYs), which was 11% of all DALYs lost around the world. A large injury burden lies in sub-Saharan Africa, where injuries contributed to over 7% of all DALYs lost in the region.[2] Between 1980 and 2010, road traffic injury (RTI) death rates increased by 29.8% in the southern region.[3] In western sub-Saharan Africa, this increase was 15.2%, and motorized road transport was the third leading cause of death and one of the top five risk factors for loss of DALYs in 2010.

The role that socioeconomic status plays in generating injury disparities is critical.[4] In the 1980s, socioeconomic status had been defined as "the relative position of a family or individual on a hierarchical social structure, based on their access to or control over wealth, prestige, and power" and "a composite measure that typically incorporates economic status, measured by income; social status, measured by education; and work status, measured by occupation."[5] Two decades later, it was defined as "a broad concept that refers to the placement of persons, families, households, and census tracts or other aggregates with respect to the capacity to create or consume goods that are valued in our society."[6] Socioeconomic status has also been explored through a capability approach, which focuses on freedom and ability to develop one's potential.[7]

Previous work has identified a number of socioeconomic disparities. First, sex differences in injuries are conspicuous in sub-Saharan Africa, as the average burden per 100,000 female population in 2013 was 2,904 disability-adjusted life years (DALYs), but among the male population, the loss of health was 5,613 DALYs (Table 2).[2] The 2013 Global Burden of Disease (GBD) research also estimated the percentage of total DALYs lost to specific injury causes such as road traffic injuries (RTIs), interpersonal violence, self harm, and drowning by sex. These estimates were about two to three times as large among males than females, again demonstrating that injuries are a larger health concern among men. Second, in low- and middle-income countries (LMICs), higher levels educational attainment have been found to both increase and decrease injuries of various causes including interpersonal violence, self harm, RTIs childhood burns, animal bites, and poisoning.[8-17] Third, material wealth appeared to have an inverse relationship with the incidence of injuries of various causes found that higher levels of household wealth provided protection in a number of settings,[15,17-20] but a positive association has also been observed in South Africa and Sudan.[17,21]

Despite this growing body of literature, a number of questions remain. Very few of the studies on the socioeconomic disparities of injuries include injuries of all causes and only a handful was conducted in sub-Saharan Africa. What role does SES play in generating injury disparities in countries such as Uganda? Achieving a deeper understanding of this issue will fill a gap in the existing literature on the relationship between SES and injuries and inform policy and planning by identifying population groups vulnerable to injuries.

Conceptual framework

A conceptual framework was constructed to guide the design and analysis of this study, and it is based on three existing frameworks. First, to explain the patterning of disease and death, Link and Phelan developed the fundamental cause theory to highlight the dynamic process through which social conditions such as sex, ethnicity education, and income affect health. When effective interventions or preventative measures become available to a population, those who have greater access to wealth, power, prestige, and beneficial social networks confer the health advantage to protect or treat themselves. This framework thus compels one to examine how social conditions shape risk factors for illness and death. Similarly, World Health Organization's Commission on Social Determinants of Health developed a framework to explain health equity, and this framework presents immediate causes of health that exist within the "circumstances of daily life, " such as biological factors, behaviors, material conditions, psychosocial factors, and the health care system, including availability of health care promotion, disease prevention, and treatment of illness.[22] But the Commission put forth their understanding of health determinants as going beyond the immediate causes. One of the "causes of the causes" is social position, which the Commission operationalizes through the indicators of education, occupation, income, gender, and ethnicity and race.

While the determinants of health are strongly sociological in nature, the distribution of health and well-being, in turn, influences social hierarchy. This process is captured by the second framework of interest to this study: the Financial and Economic

Impacts of Disease or Injury on Households (Figure 1) by the *World Health Organization (WHO) Guide To Identifying the Economic Consequences of Disease and Injury*.[23] An ill health event can impede a household's ability to achieve the three utility objectives of maximizing leisure time, consumption of home-produced goods, and consumption of non-health market goods. The household may suffer losses in paid or unpaid production, increase of consumption of services and goods related to care required for the ill health event, and decrease of consumption of non-health goods and services such as food and clothing.

Capturing and incorporating these key relationships between socioeconomic status and injuries, a conceptual framework was created (Figure 2), and this study will follow and focus specifically on the top half of the framework, the socioeconomic disparities of injury. One can then understand that indicators of education, occupation, income or assets, gender, and ethnicity or race influence the latent construct of socioeconomic status, as shown at the top of the framework. The indicators of education, occupation, income or assets, gender, and ethnicity or race influence the latent construct of socioecononomic status. This position in society then influences the "circumstances of daily life" such as choosing not to wear a bicycle helmet, having frail bone structure, working in an area that has poorly constructed roads, and feeling psychological stress. Finally, the availability of quality health care for injury varies from circumstance to circumstance. In this study, the link between injuries and wealth, prestige, and/or power is of great inquiry.

Goals and Objectives

The overall goal of this study is to determine and measure the socioeconomic disparities in injury occurrence in the Iganga and Mayuge districts of Uganda.

The following specific objectives were developed to achieve the goal stated above: (1) to measure the disparities in population-based injury rates by sex of the injured individual and sex of his or her household head and determine the effect of sex on the odds of experiencing an injury, and (2) to measure the disparities in population-based injury rates by household wealth and determine the effect of household wealth on the odds of experiencing an injury.

These objectives will building upon previous work studying the health and SES relationship, perhaps reaching a new understanding for an important and neglected disease burden. It will contribute to an ongoing discussion on injuries and SES, extending prior research on the injury and SES relationship and shedding new light on injuries in the African region. To our knowledge, this will be the first such study on the socioeconomic disparities of injuries in Uganda. The hypothesis for this study is that injuries demonstrate a socioeconomic gradient where people with greater resources or higher status gain protection from injuries, but this relationship will not hold for some injuries such as road traffic injuries.

Methods

Study site, design and data sources

This cross-sectional study utilizes four datasets from a Demographic Surveillance System, which is a population-based site that tracks demographic events and monitors health in a geographically defined population over time.[24] The Iganga-Mayuge Demographic Surveillance Site (IM-DSS) was established in partnership with Makerere University in 2005 with the goal of generating information to support evidence-based decisions and policy making in the Iganga and Mayuge districts but also at a national level. The site is based in a predominantly rural region in eastern Uganda, about 120 km east of the capital Kampala (Figure 3). All field assistants come from the Iganga and Mayuge communities and interviews are conducted in the local language of Lusoga. Before each round of data collection, the IM-DSS field team members undergo a rigorous initial or refresher training. All survey instruments were consistent with other demographic surveillance sites which are part of the international INDEPTH network.[25]

The first source of data is the health and demographic data on all individuals from all households located in the site, and this information is collected every four months by the IM-DSS field team using a paper-based household survey. The demographic information includes migrations, births, age, sex, deaths, and verbal autopsy (Table 1).

Second, the site has collected household socioeconomic information during October 2008—March 2009. These data include occupation of the household head, physical characteristics of the household such as the materials used for the roof and main source of water, and ownership of various household assets (Table 1).

Third, this study uses a database developed by the IM-DSS to classify each of the 65 villages in the area as either rural or peri-urban based. All villages that formed the Iganga Town Council were considered peri-urban while the majority of villages fell into the rural category with some exceptions.

Fourth, in 2008, the Johns Hopkins University International Injury Research Unit (JH-IIRU) partnered with the IM-DSS to explore innovative approaches to screen for disability and to characterize it through an in-depth disability and injury assessment module that was designed to be incorporated into regular IM-DSS data collection (Appendix 1).[26,27] The injury component of this survey asked the head of each household (or the senior most member of the household present at the time of the interview) if any member of the household had an injury in the last four months. The four-month period was chosen because the IM-DSS collects data once every four months. Injuries were defined as an event that prevented the victim from carrying out normal daily activities for at least one day or for which the household paid for any treatment, and the cause of the injury was also recorded. The first data collection took place during February—April 2009 while the second round took place during March—May 2010.

A cross-sectional survey then followed up with all individuals who reported an injury and began with the question of when was the subject's most recent injury. In addition to collecting information on the type of injury, health care that was sought and received following the injury, and socioeconomic consequences of the injury (Appendix

2), these interviews fulfilled the objective of validating the injuries reported through the injury assessment module and included in this study.

Sample

The study sample was determined by the distribution of two independent variables of interest. First, among the individuals who were present in both the 2009 and 2010 rounds, differences in time variant variables were detected because some individuals moved to a different household between rounds of data collection, leading to changes that include moving from a male headed household to a female headed household, moving from a rural village to a peri-urban region or vice-versa, or shifting from the highest wealth quintile to the second highest. In contrast to the rest of the individuals who exhibit constancy in these time-varying, this group must be treated differently. However, they made up only 0.25% of the entire sample and were thus excluded. Second, the injured individual's household wealth is measured through an asset index (further explained in the next section). The peri-urban sample presented missing asset data that was identified as being problematic, so this study focuses specifically on the rural region of the IM-DSS.

Outcome variables

This study's major outcome of interest is whether or not an individual experienced an injury of any cause in the last four months. Additional outcomes include whether or not an individual experienced an RTI and the type of road user among those who experienced an RTI.

Independent variables

In the interest of identifying disparities by socioeconomic status, this study's set of independent variables of interest include sex of the injured individual, sex of the household head, and household wealth. Sen developed a theory that the endowment of authority, control, and resources to men entangles with high-risk behaviors and increases vulnerability to poor health outcomes and proclivity to injury,[28] and such a framework aligns well with this study's conceptual framework and supports the inclusion of sex of the injured individual and sex of the household head. Measuring assets has the benefits of a lower likelihood of recall or measurement problems, and some argue that it provides a better picture of long-term living standards than income.[29,30] Control variables include the individual's age group, the household head's occupation, and, since not all individuals were present for both rounds of data collection, the number of times included in the injury surveillance.

To construct a wealth quintile variable and handle the high-dimensional nature of asset data, a principal components analysis (PCA) was conducted.[30] In this analysis, each asset is a random vector of dimension p with a finite p x p variance-covariance matrix. Two kinds of variables were included in the PCA (Table 2): dichotomous variables, representing household ownership or non-ownership and taking on the values of either zero or one; and discrete and ordinal variables, such as main source of light. To handle the discrete and ordinal nature of information, covariances between variables were estimated using a polychoric correlation.[31] The PCA then identifies patterns in the information on assets, highlights similarities and differences, and reduces the high-dimensional data to orthogonal linear combinations of variables, a simpler dimension that captures the underlying construct. The linear combination of asset scores with the greatest amount of information common to all of the variables, represented by the largest variance of the projections of the vectors, is known as the first principal component. The percentage of variance in the asset items demonstrates the extent to which the variation in asset items between households can be explained by this one measure of SES.

The strength of the association of an item with this first principal component determines the weight of the items in the asset index, or the factor score. An important assumption for the model is that this first principal component represents the construct of household wealth.[30] The asset index score (A_j) for each household *j* is calculated as follows:

$$A_j = f_1 \times (a_{j1} - a_1) / (s_1) + \ldots + f_N \times (a_{jN} - a_N) / (s_N)$$

where
f_1 = the "scoring factor" for the first asset as determined by the analysis
a_{j1} = the *j*th household's value for the first asset
a_1 = the mean of the first asset variable over all households
s_1 = the standard deviation of the first asset variable over all households

Then, looking at the frequency distribution of the asset index scores of the households, a distribution that is weighted in the same way that the items in the asset index are weighted, this study will rank households by their individual scores and create cutpoints to divide the distribution into quintiles, or five sections constituting 20% of the sample.

Constructing an asset index for the combined 9,323 rural and 3,569 peri-urban social groups can misclassify a household's quintile, particularly in situations where one asset may indicate greater wealth in one location but lesser wealth in another.[32,33] A stratified analysis that differentiates the sample by the village development would be the best approach to studying socioeconomic consequences and controlling for characteristics such as household wealth. Asset data were missing for both rural and peri-urban groups, but the quantity and characteristics of the missing peri-urban data called for attention and caution before carrying out the analysis. In working with the IM-DSS investigators to understand the reasons for why data were missing for 1,392 out of 3,569 social groups, it was found that many of these social groups either moved to the IM-DSS after the socioeconomic data were collected and the field assistants did not follow up on them or were undergoing internal movements at the time of the socioeconomic data collection and were difficult to trace.

However, the lack of data for 796 of the 1,392 urban social groups (22.4%) was likely due to one of the following reasons: (1) only minors were at home during all of the times when the interviewers visited the household, (2) no one was home during all of the times when the interviewers visited the household, and (3) the house was demolished and the social group could not be traced during the socioeconomic data collection round. These three conditions could likely be characteristic of socioeconomically disadvantaged households where all members have to work, supervision of children is not possible, and control over property is weak or nonexistent. A relationship may then exist between the propensity of asset data to be missing and the values of those asset data, meaning that the poorer households may be more likely to have missing data. A sample with Missing Not at Random (MNAR) data is thus non-representative and would yield biased results.[34] A general consensus on what is considered a passable amount of missing data does not currently exist. In a review of education and psychology studies, the maximum proportion of missing cases was over 27%.[35] This study made the decision that the 22% missing urban asset data would pose a threat to statistical conclusions and generalizability, so this study focuses specifically on the rural region of the IM-DSS.

Among the 7,355 rural social groups that have asset data, the selection of assets began with gathering expert opinions from the Uganda-based investigators, as their local knowledge helped identify which variables do not perform well in differentiating the wealth of one household from that of another.[36] First, given the greater availability of land to a rural household, burning waste and disposing waste, particularly biodegradable waste, in the gardens is practiced by both affluent and less affluent homes. Second, the main source of drinking water and type of toilet used by the household often depends on the infrastructure available on a community level, so this variable was omitted in the interest of separating community from household wealth effects. Third, the dichotomous variable on land ownership was also described as being ambiguous, as it does not capture the quality of land. Similarly, information on household's type of dwelling tenure does not accurately portray the household's wealth. The majority of the 7,355 households constructed and own their dwellings (74%) while 12% rent from an individual. But attaching a monetary value to this type of asset ownership is complicated due to a weak housing sale and rental market and because construction of these houses often uses found materials and/or minimal material resources.[37,38] Data on the quality of the dwelling's materials such as those used for the roof, wall, and floor, are included in this analysis, but type of tenure is not. Finally, data from a 2005 IM-DSS round reveal that out of 60,228 participants, 55% were Muslim, so owning a pig was omitted from the asset analysis.

Descriptive analyses also identified assets that should be excluded due to a large proportion of missing data. All of the variables on the quantity of a specific food, such as rice, maize, or millet, stored by the household at the time of the interview had missing data for more than three quarters of the rural households. Information on availability of shutters and on whether or not the household land or plot was enough to grow food to feed its members had missing data for more than 20% of the household sample, so this variable was removed from the analysis as well.

The estimation of covariances between the asset variables through a polychoric correlation brought attention to variables that cause missing correlation: ownership of a car, gas or electric cooker, a car, a truck, bus, or tractor, a landline phone or a bed. These binary variables have a very small group of ones or zeros, a quality that does not conform well to the polychoric assumption that two latent bivariate normally distributed random variables generate two observed ordinal scores.[31,39] Using the final set of assets (Table 2), a raw total asset score was calculated for each of the 7,355 households. The 0.29 skew of this score variable and the appearance of the histogram in comparison to a normal distribution curve indicate a slightly positive skewness (Figure 4). The PCA reduces the dimensions of these asset data so that the first principal component represents household wealth. The proportion of variance explained by this first principal component can affect the index's risk of misclassifying a household in the wrong group, so this study aimed to build an index where the first component explained at least 30% of the variance. In this study, the first principal component based on the final set of asset variables accounted for 32% of the variance (Figure 5).

Two additional indices were created with the purpose of comparing different weighting methods and their impact on household classification results. First, selecting from the same set of variables used for polychoric PCA-based index, this study conducted the PCA method that was originally developed for the multivariate normal distribution using the Pearson's correlation matrix.[40] The resulting index, however, presented problems that warranted attention. Due to numerous weak coefficients displayed in the correlation matrix, extensive variable pruning was required to yield an index with a first component explaining 28.6% of the data (Figure 6). This final set excluded more than two-thirds of the total number of assets including in the polychoric PCA-based asset index, a very noticeable loss of rural household asset information (Table 2). Furthermore, the slightly positively skewed score distribution (Figure 7) appears uneven and reveals that large proportion of households have the same score. This clumping quality can impede one's ability to create even wealth quintiles and properly differentiate between households by wealth.[41] Due to these potential threats to being able to distinguish between the relative poorer and richer households, the Pearson correlation-based PCA asset index was not included in this analysis.

A second alternative approach to constructing an asset index is the simple sum of assets, and previous studies have used this straightforward method that computes a sum across binary asset variables and equal weight to asset regardless of its quality.[42-44] This index included all of the variables used for the polychoric PCA-based asset index (Table 2), but six categorical variables were recoded into binary ones. Expert opinions from the Uganda-based investigators were solicited to ensure that the dichotomy of theses variables was appropriate and meaningful (Table 3). The resulting sum of assets index score had a very low value of positive skewness (0.09) and a fairly even normal distribution.

Finally, the 7,355 households were classified into quintiles based on their asset index score built through polychoric PCA method as well the simple sum of assets method for the sake of comparison. For example, the first quintile consists of the poorest individuals whose score values comprise the lowest 20% of the index.

Analysis

<u>Chi-square analysis</u>

In exploring the relationships between two categorical variables, Pearson's chi-squared tests evaluated the likelihood that observed sociodemographic differences between the burn injuries and the non-burn injuries arose by chance.[45] The test statistic is defined as

$$\chi^2 = \Sigma (O_i - E_i)^2 / E_i$$

where O_i is the observed frequency for bin *i* and E_i is the expected frequency for bin *i*. The expected frequency is calculated by

$$E_i = N^*(F(Y_u) - F(Y_l))$$

where F is the cumulative distribution function for the distribution being test, Y_u is the upper limit for class *i*, Y_t is the lower limit for class *i*, Y_l is the lower limit for class *i*, and N is the sample size.

Injury incidence rates and rate ratios

The injury surveillance module detected injuries that occurred within the last four months, so this study assumed that each individual present in only one round of data collection contributed four person months and that each individual present in two rounds of data collection contributed eight person months. Placing the number of events in the numerator and pooling the total person time from both the 2009 and 2010 data collection rounds for the denominator, this study calculated injury rates and RTI rates per 1,000 person-years. The 95% CIs were calculated using the quadratic approximation to the Poisson log likelihood for the log-rate parameter:[46]

Lower bound = $[\chi^2_{(\alpha/2), 2d}] / 2$
Upper bound = $[\chi^2_{(1-(\alpha/2)), 2(d+1)}] / 2$

where d is the number of events and $\chi^2_{v, a}$ is the $(100^* \alpha)^{th}$ chi-square centile with v degrees of freedom.

Regression models

The RTI and injury data demonstrate an over-dispersion, so to estimate how incidence rates vary by the independent dummy variables of interest, comparing one group of individuals to a base group, this analysis built a negative binomial regression model.[47] This model starts with a Poisson regression model[48] where the Poisson probability distribution is

$\Pr(Y=y|\,\lambda) = (e^{-\lambda} * \lambda^{\lambda}) / y!$ for $y = 0, 1, 2$

where λ is the mean or expected valued of a poisson distribution as well as the variance of a poisson distribution

The maximum likelihood of a Poisson regression model is

$$L(\beta \mid \mathbf{y},\mathbf{X}) = \prod_{i=1}^{N} \Pr(y_i \mid \mu_i) = \prod_{i=1}^{N} \frac{\exp(-\mu_i)\mu_i^{y_i}}{y!}$$

where $\mu_i = E(y_i|x_i) = \exp(x_i\beta)$

To examine the outcomes that have a binary nature, this analysis built logistic regression models.[49] The observed outcome variable *y* was understood as capturing some information about a latent variable *y** that ranges from $-\infty$ to $+\infty$ and that is linearly related to the observed independent variables. This latent value represents an underlying propensity for the outcome and generates the observed *y*'s. Respondents who have larger values of y^* are observed as y=1 while those with smaller values are observed as y=0. The estimation equation is as follows:

$$\mathrm{Ln}\ [(\Pr\ (Y_{ij}=1)/(1 - \Pr\ (Y_{ij}=1)]$$
$$= \mathrm{Ln}\ [(\Pr\ (Y_{ij}=1)/(\Pr\ (Y_{ij}=0)] = \beta_0 + \beta_1\, x + \beta_2 \mathrm{injury}$$

where
x_i is a vector of covariates
β_0 is the baseline value for observations with all covariates equal to zero

Maximum likelihood (ML) was used for model estimation under the assumption that the errors follow a logistic distribution. The coefficient values resulting from this estimation were transformed into the more interpretable odds ratio of the outcome. Since previous research in South Africa found that local and environmental factors influenced the occurrence of injuries,[19,50] this model adjusted for the variance of the village as a cluster and obtained robust variance estimates that adjust for within-cluster correlation.[51]

As discussed in the PCA discussion, a general consensus on what is considered a passable amount of missing data does not currently exist. This study made the decision that a variable with data missing among over 20% of the households would pose a threat to statistical conclusions and generalizability. For a variable missing less than 20% of the sample's data, in response to the potential threat to making valid references, this study implemented multiple imputation, which has been shown to generate unbiased parameter estimates reflecting the uncertainty associated with estimating missing data and to perform adequately even in datasets with large amounts of missingness.[52-54] This method creates regression models for each variable to calculate and fills in missing information, and multiple rounds of this procedure results in a combined imputed data set that can be used for one overall analysis. This study employed the chained equation approach to multiple imputation, which assumes that missing data are missing at random and runs a series of regression models so that each variable with missing data is modeled according to its type of distribution (e.g. logistic or multinomial) conditional upon the other variables in the data.[55]

Results

A total of 74,938 individuals lived in the IM-DSS during February—April 2009 and/or March—May 2010. Two groups were excluded from this analysis: the 15,624 individuals living in peri-urban areas of the IM-DSS and the 66 people who moved from one household to another and exhibited changes in time varying variables such as sex of the household, thus leaving a final sample of 59,248 individuals at risk of an injury.

Females constituted nearly 54% of the population (Table 4). Young adults are a large segment, as 28% of the individuals had between 15 and 29 years and 48% were under the age of 15 years. The majority (64%) relate to the household head as his or her child, grandchild, or stepchild. Most individuals came from male-headed households (83%) as well as households led by a farmer (38%) or a shop/business worker (22%). The majority (86%) of the subjects were present during both 2009 and 2010 rounds of data collection. The distribution of wealth differed by the approach to building an asset index. For example, the highest quintile included 27% of the population according to the PCA-based measure but 19% according to the simple sum-based measure. Injuries afflicted 762 individuals (1.3%) in a four month period in the rural IM-DSS, and the most common injuries were RTIs (0.5%) and unintentional falls (0.3%). Among the 324 individuals who experienced an RTI, the majority was on a bicycle at the time of the injury (62%) while 27% were in a motorized vehicle.

Among the 9,323 individuals who were identified as the household head, nearly 79% were male, 41% were between the ages of 30 and 44 years, and 68% were married (Table 5). The dominant occupation was farming (43%) followed by working in a shop/business (17%). The injured group included 295 individuals, or 3.2% of the household head population, and 185 of these injuries were caused by RTIs.

The sex of the household head created significant variation in three key sociodemographic characteristics (Table 6): age ($\chi 2=618.3$, $p<0.0001$), marital status ($\chi 2=3123.4$, $p<0.0001$), and occupation ($\chi 2=741.3$, $p<0.0001$). The over 60 years of age group made up a larger percentage of female household heads than male ones (38.2% vs. 15.9%) while male household heads had a greater percentage of individuals between 30 to 44 years age (46.6% vs. 26.1%). The most striking difference is that the great majority of male household heads are married (86.2%) while the majority of female household heads did not have a partner due to being widowed, divorced, separated, or never married (69.1%). Finally, differences in occupation were found as female household heads had a much more prominent unemployed group (17.6% vs. 3.3%) and a larger group employed in farming and agriculture (53.1% vs. 39.7%), while males had more than twice the percentage of individuals who were wage laborers (20.3 vs. 8.1%).

All–causes injuries

Incidence rates and rate ratios

In the rural village areas of the IM-DSS, 762 injuries occurred over 36,776 person-years, resulting in an injury incidence rate of 20.7 injuries per 1,000 person-years (Table 7). The rate was higher among males than females (27.3 vs. 14.7), and surprisingly, a positive injury trend by age group is evident, as the injury rate begins with 11.8 per 1,000 person-years among those under the age of five, increases to 14.0 among those of five to 14 years, and then climbs to 34.2 among those of 30 to 44 years of age, 41.9 among those between 45 to 59 years of age, and 44.8 among those over the age of 60 years. The rate among male household heads was slightly lower than that among females (20 vs. 23 per 1,000 person-years). Individuals who had a household head who was a bodaboda driver or who was not employed had incidence rates of 30.0 and 27.0 per 1,000 person-years, respectively. Among the wealth quintiles built by a PCA-based asset index, the highest rate was experienced by those in the lowest or poorest one (25.2 per 1,000 person-years) while a rate of 20.6 per 1,000 person-years was observed in the highest quintile (21.0 per 1,000 person-years).

In both the unadjusted and adjusted negative binomial regression models (Table 8), the difference by sex was significant (IRR, 1.86, 95% CI, 1.64, 2.12 and IRR, 1.93, 95% CI, 1.67, 2.24). Compared to the youngest age group of under five years, the injury rates in the four age groups older than 15 years were significantly higher in both the unadjusted and adjusted models. Coming from a male headed household had a protective effect in the multivariable model (IRR, 0.79, 95% CI, 0.65, 0.97). Having a household head who worked as a bodaboda driver, as opposed to a professional, increased the injury rate in unadjusted (IRR, 1.52, 95% CI, 1.05, 2.19) and adjusted model (IRR, 1.79, 95% CI, 1.18, 2.72). The all-causes injury rate does not significantly vary by a PCA-based measure of wealth, but in the multivariable model that uses a simple sum of assets-based measure of wealth, the second highest quintile increased the injury rate by 1.3-fold (95% 1.03, 1.64)

Odds ratios

As expected, the logistic regression models reveal significant variation by the same factors identified in the negative binomial regression models: sex, age, household sex, and household head occupation (Table 9). The odds of an injury were higher among males than females in the unadjusted (OR, 2.0, 95% CI, 1.76, 2.29) and adjusted (OR, 1.92, 95% CI, 1.67, 2.2) models. Compared to those under the age of five years, the odds significantly increased by all older age groups over 15 years, and as the groups increase in age, the odds ratios increase in magnitude. In the adjusted multivariable model, male-led households had 0.79 times the odds of an injury compared to those from female-led households (95% CI, 0.65, 0.997). Individuals from households led by a bodaboda driver were significantly more likely to experience an injury than those living in households led by a professional (unadjusted OR, 1.54; adjusted OR, 1.76). Household wealth and injuries did not have a significant relationship nor was there an apparent trend. Compared to those in the highest wealth quintile in the multivariable model, the odds of an injury were 11 percent higher among those in the second highest quintile, 12 percent lower among those in the middle group, 13 percent lower in the second lowest group, and four percent higher among those in the poorest quintile. Moving from the highest quintile to the second highest one appeared to increase the injury rate when wealth was measured through a simple sum of assets (IRR, 1.3, 95% CI, 1.03, 1.63)

Road traffic injuries

Incidence rates and rate ratios

A total of 324 RTIs were detected over 36,776 person-years from 2009 and 2010, yielding an overall RTI incidence rate of 8.81 RTIs per 1,000 person-years (Table 10). The rates were highest among those between 30 and 45 years (21.2 RTIs per 1,000 person-years), and a larger rate is again observed among members of households led by a male or a bodaboda/taxi driver. The wealthiest and second wealthiest quintiles had the highest RTI incidence rate (10.0 and 10.4 RTIs per 1,000 person-years, respectively).

Incidence rate ratios

Compared to the models for all injuries, being male had an even greater effect on RTI incidence in the unadjusted (IRR, 2.99, 95% CI, 2.18, 4.04) and adjusted models (IRR, 3.03, 95% CI, 2.37, 3.89) (Table 11). Belonging to any age groups older than 15 years significantly increased the probability of an injury, and the effect of falling in the group of 30 to 44 years had a particularly large effect with an adjusted IRR of 6.62 (95% CI, 4.79, 9.14). Unlike the results obtained by the models for injuries of all causes, RTIs did not have a significant relationship with household head sex, but they did have one with the head's occupation, specifically bodaboda drivers compared to professionals (unadjusted IRR, 2.54, 95% CI, 1.39, 4.63; adjusted IRR, 0.86, 95% CI, 1.58, 4.18).

Odds ratios

Expectedly consistent with the results from the negative binomail model, the odds of an RTI were higher among males in the unadjusted (OR, 3.21, 95% CI, 2.34, 4.4) and adjusted (OR, 3.01, 95% CI, 2.15, 4.21) models, and this increase in odds was higher than that found in the logistic model for injuries of all causes (Table 12). In comparison to those under the age of five years, all age groups had significantly greater odds of an RTI, and those between the ages of 30 and 44 had the highest odds ratio (unadjusted OR, 7.02, 95% CI, 4.98, 9.89; adjusted OR, 6.65, 95% CI, 4.68, 9.45). The odds of experiencing an RTI were greater among those whose household heads were bodaboda drivers than those living in households led by a professional (unadjusted OR, 2.01, 95% CI, 1.35, 2.99; adjusted OR, 2.17, 95% CI, 1.45, 3.26). Both models including alternative measures of household wealth did not exhibit a trend for RTIs.

Type of road user

Dividing the 324 individuals who experienced an RTI into two categories of road users, motor vehicles and bicycles or pedestrians, the unadjusted and adjusted models found that the odds for being in a motorized vehicle were higher among those who had between 30 and 45 years of age and even higher among those over the age of 45 years (Table 13). Individuals who experienced an RTI and came from households led by a farmer had significantly lower odds of being in a motor vehicle than did those whose household were led by a professional or someone working in business (unadjusted OR, 0.46, 95% CI, 0.22, 0.97; adjusted OR, 0.42, 95% CI, 0.22, 0.8). Surprisingly, the type of road user did not have any relationship with household wealth, measured either through a PCA-based asset index or a simple sum of assets.

Discussion

This cross-sectional study in the IM-DSS identifies and describes the social conditions for injuries, and these markers of socioeconomic status include sex of the injured, sex of the household had, and household wealth. The rural injury rate was 20.7 injuries per 1,000 person-years. This number is a bit higher than the annual rate for fatal, disabling, and recovered injuries in the southern rural district of Mukono, where the estimate of 17.8 per 1,000 person-years was also drawn from household survey data.[56] But in the centrally located rural Mubende district, a trauma registry form found that the annual injury prevalence rate was 118.8 per 100,000 persons. The RTI incidence rate in the rural IM-DSS was 8.8 per 1,000 person-years, which is again higher than the rate of 2.6 RTIs per 1,000 person-years in Mukono.

One explanation for the higher RTI rate in Iganga and Myauge is that the Mukono data were collected in 2001 and in the time that has passed since them, Uganda has witnessed rapid urbanization. One way to measure the level of urban concentration is the agglomeration index, which first sets a threshold for three indicators of population density, population size of large urban centers, and travel time to the nearest urban center, then estimates the population living in areas that meet those criteria, and finally calculates the ratio of that population in the agglomeration area to the country's total population.[57] In eastern Uganda, the urbanization level according to this index jumped from 21.8% in 2002 to 33.2 in 2010.[58] During this time period, the government made improvements in road infrastructure, and the percentage of the eastern Uganda population able to reach an urban center of 50,000 people or more in less than an hour increased from 20.1% to 28.7%. While the villages in this analysis fall into the "rural" category, others have argued that such a dichotomous classification does not capture the more small-scale increases in and complexity of "urbanicity," defined as the presence of conditions more commonly found in urban areas such as economic activity, transportation infrastructure, and communication services.[59,60]

Factors associated with injuries, RTIs, and type of road user

Men had the clear disadvantage of being susceptible to injuries, as their incidence rate was twice that observed among women, and being male significantly increased the odds of experiencing an injury. These findings confirm previous knowledge on the sex and injury relationship in Uganda and in other sub-Saharan African countries.[4,56,61-65] And according to the Global Burden of Disease 2013 (GBD 2013) assessment of injury death rates in Uganda, the male death rate was more than twice as high as that for the female rate (99 vs 41.7 deaths per 100,000 population) while the DALY rate was 1.8 times as higher (6,010 vs 3,359 DALYs per 100,000 population).[2] Being male had an even stronger impact on RTI incidence in the rural IM-DSS. Similarly, the GBD 2013 found that the percentage of total deaths attributable to RTIs was 2% among females and 5.7% among males, while the percentage of total DALYs lost attributable to RTIs was 1.5% among females and 4.5% among males. This RTI differentiation by sex is unsurprising given the limited mobility observed among females rural sub-Saharan Africa.[66] While males have been the main beneficiaries of transport technology, the dominant form of transport for women is walking, even when taking on duties such as collecting water, traveling to fields, and carrying heavy loads of supplies or goods related to housework or agricultural production. Forces underlying the relative immobility among women of all ages include insufficient resources to pay for transport fares, expectations to focus on housework, and social norms that females who travel long distances are suspicious or even promiscuous.[67] However, it was surprising to find that among those who experienced an RTI in the rural IM-DSS, being a male did not significantly increase the likelihood of being in a motorized vehicle rather than being on a bicycle or a pedestrian. Perhaps the road user disparity by sex would be greater if this study had a larger group of RTI cases so that pedestrians could belong in its own group.

While being male increased the risk of injuries of all causes, having a male household head offered protection, and this result agrees with the findings that belonging to a female-headed household in South Africa increased the risk of childhood burn injuries[19] and, similarly, the risk of asthma, tuberculosis, scabies and diarrhea.[68,69] Most of the female household heads in the rural IM-DSS were widowed, separated, divorced, or never married, and two studies in sub-Saharan Africa have found that in the absence of a partner and the scarcity of male labor, female heads often try to fulfill both home and work responsibilities and face time constraints which restrict access to social and health service.[70,71] In Uganda, the gender inequalities were observed in the household head's educational attainment, as men achieved higher levels than women.[72] Previous studies have also found that female heads are subject to lower levels of formal and informal sector employment and decreased farm-based cash income.[68,69] It is possible that some or all of these socioeconomic disadvantages associated with female-headed households would widen the range of injury hazards and limit the knowledge or means necessary to protect household members from an injury.

Household wealth, however, did not affect one's risk of experiencing an injury or RTI. One exception was that when wealth was measured as a simple sum of assets, one association showed that the second highest group was at 1.3 times the odds of an all-causes injury. These finding of a lack of relationship are unexpected given that previous studies have found that higher levels of household wealth provided protection against injuries of various causes including RTIs[15,17-20] while others found that the relationship with injuries including RTIs followed the opposite direction (Table 14).[17,21]

One explanation for the finding that household wealth and RTIs do not have a relationship comes from a theory that served as a foundation for this study's theoretical framework: Link and Phelan's fundamental cause theory.[73] Having high socioeconomic status increases one's access to resources, such as knowledge, money, power, and prestige, and these advantages can be used to avoid the risks of death and disease, but their framework highlights a situation when having more resources has no bearing on access to prevention measures: when effective interventions are not yet developed or well implemented. They refer to the period of time when screening for deadly cancers was nonexistent in United States as an example of such a situation. One must consider the idea that current RTI interventions and advances in RTI prevention in the rural IM-DSS are simply insufficient, thus leading to what appears to be socioeconomic equality. In the past, strong arguments have been made for greater financial commitment by governments and donors to enforce traffic safety and ensure safe road travel,[74] and this study helps elucidate that needs are still gravely unmet for even the populations of greater wealth and resources are poorly equipped to protect themselves from RTIs.[75]

Second, Link and Phelan consider another factor that would disrupt the persistent inverse association between socioeconomic status and disease: situations where the objectives of improving or maintaining health and achieving social status clash. While privilege can be used to live in better health, another personal interest related to power, self-esteem higher socioeconomic status may drive one to engage in risky behavior. For example, a study on driving practices among post-graduate university students in Durban found that young males were more likely to display the personality traits of anger, sensation seeking, and impulsivity, and thus engage in risky driving behavior.[76] Further work should explore if unsafe driving practices significantly vary by household wealth.

An explanation for the finding that household wealth and all-causes injuries do not have a relationship is that within each cause of injury, there is a range of possible vectors, characteristics and conditions that may be influencing the risk in different magnitudes and directions. This IM-DSS injury module must continue as an ongoing, continuous data collection that can capture a larger sample of reported injuries, collect information on risk factors, and explore the socioeconomic risk factor patterns.

Only one household head occupation increased the incidence of injury: bodaboda drivers. It is likely that this condition put the household at risk not because of specific level of income or wealth but rather because of access to the physical vector of injuries, a motor vehicle. The effect of having a household head in a bodaboda driver occupation on having an RTI was positive, significant, and greater in magnitude than that observed in all-cause injuries, which again should be related to the increased access to bodaboda vehicles and exposure to hazardous driving.

Finally, the relationship between age and injury in the rural IM-DSS is notable. While other findings have also found that injuries impose a smaller burden on children compared to adults, the reported number of all-causes injuries experienced by those who fell in the under five years of age group was still very remarkably low and warrants the concern of under-reporting. If parents from poorer wealth quintiles were less likely to report a child injury than their wealthier counterparts, then this study's estimates of the relationship between wealth and injury could be biased to the null. The highest rate of all-causes injury was observed among the oldest age groups of 45 to 60 years and over 60 years. Restricting the focus to RTIs, the highest rate was observed among those between 30 and 45 years. For both RTIs and injuries, all age groups over 15 years had significantly greater odds of experiencing the outcome compared to those under the age of five years. Similarly, GBD 2013 found that the injury death rate was among those between 50 and 69 years of age (135 per 100,000 population), and this figure was far larger than that observed among the age groups of less than five years (81 per 100,000 population) and five to 14 years (19 per 100,000 population).[2] The highest RTI death rate was observed among those who had between 15 and 49 years (9.3 deaths per 100,000), and again similar to the IM-DSS, this estimate is much higher in comparison to those under the age of five years (1.4 deaths per 100,000).

Type of road users

The majority of the individuals who reported an RTI were on a bicycle, while more than a quarter was in a motorized vehicle and 11% were pedestrians. This distribution differs from the study results by Naci et al, who found that road traffic fatalities were highest among motorized four wheeled vehicles in the Afr-D (high child and high adult mortality) WHO region and among pedestrians in the Afr-E (high child and very high adult mortality) WHO region.[77] While socioeconomic factors such as household income were associated with type of road user in Kenya,[78] road user group in the IM-DSS did not have an association with the injured's sex, the sex of the household head, nor household wealth quintile. Perhaps these results stemmed from the way in which road users were categorized, as not being able to distinguish between multi-passenger vehicles such as the minibus "matatus" from trucks and motorcycles may be less conductive to detecting differences by wealth.

Limitations and strengths

A number of measurement errors are of concern to this study. First, the outcome variable of an incident injury relies on the report from the head of the household or the senior most member of the household present at the time of the interview, and the definition of injuries may be vague or difficult for a field assistant to explain. Thus, there is a possibility that injuries were under-reported, and if these missed cases were more likely to occur among those with lower educational attainment or those from poorer households, then the estimates of association between wealth and injuries would be biased to the null. However, one strength of this study is that the injuries included in the analysis were validated through a cross-sectional follow-up study that took place in 2011.

Second, this report is on behalf of the entire household over a recall period of four months. The possible lack of knowledge of all injuries that took place and difficulties with recall may have led to the under-reporting of injuries. It has been argued that to recall information on more severe injuries in Ghana, the appropriate time period is 12 months,[79] but the severity of the injuries captured in this study is unknown and further research is needed to identify determinants of memory decay and appropriate time periods for recall on injuries in sub-Saharan Africa.

Third, the wealth quintile variable is subject to some limitations. While asset data have been shown to reflect living standards over a long period of time, a characteristic that is advantageous to this study given that asset data were collected one to two years prior to the injury surveillance, there is a concern that asset-based measures do not take into account short-term changes in resources and shocks to household.[30] If injuries are associated with more current resources available to the household, then the asset index may not as be as appropriate as the measure of consumption. Furthermore, the index is threatened by the fact that ownership of an asset does not always capture the quality of the asset.[30] Still, in the absence of being able to compare socioeconomic inequalities in an asset-based measure to those based on income or consumption, it is important to note that McKenzie validated the asset index approach through an analysis including income and expenditure data and found that asset indicators do provide a reasonable measure of inequality when income and consumption data are unavailable.[80] And since asset-based measures have had a high predictive value in estimating outcomes such as educational enrollments and malaria prevalence, the use of assets in this study also provides an important contribution to the literature on socioeconomic status and injuries.[30,81]

Fourth, the challenge of clearly defining and determining who is the head of a household poses a threat to the validity of the household head sex variable. The IM-DSS field assistants ask who is the head resident responsible for taking care of and making decisions in a home. Rosenhouse argues that by relying on the perception of power within the household, this identification process could have underestimated the number of women who are acting as the head due to the husband's unemployment, underemployment, or temporary labor migration. Furthermore, female household heads are not a homogenous group, and differences may exist between the working female heads and the non-working heads that receive financial support from children. These potential inaccuracies and lack of nuance suggest that household head sex data may be limited in its ability to reflect the welfare of a household.

Omitted variable bias is a analytical concern, for due to a large proportion of missing data, the regression models did not include the education of the household head. This socioeconomic variable is likely to determine household head occupation and it has been shown to have an association with injuries (Table 15). Exclusion of this variable could thus potentially bias coefficient estimates for sex of the individual, sex of the household head, and household wealth away from the null.

The external validity of this research also faces limitations. Findings on socioeconomic status and injuries in a rural setting are generalizable to other areas of the country. However, the mostly rural study population helps the value of this study, given the dearth of information on injuries and socioeconomic disparities in rural areas of Uganda and other sub-Saharan African countries. This study also provides a more comprehensive picture of this relationship by examining injuries in a DSS setting and including all causes.

Implications

This study yields new information for the purpose of aiding in the development of public health policies, programs, and interventions to meet the needs of individuals at risk of injuries. The finding that wealthy households were unable to protect themselves from injuries and RTIs, should be alarming to the government and other public health stakeholders. Interventions and preventive measures are gravely insufficient if even those with greater access to money, knowledge, power, and beneficial social connections are as vulnerable as their less wealth counterparts. The fundamental cause theory suggests that since disadvantaged population groups are less likely to adopt health behaviors because of their limited resources, interventions should benefit individuals regardless of their resources.[82] Phelan and Link's examples for health interventions in a Western context include air bags, window guards in high-rise apartment buildings, and legal requirements that landlords keep homes free of lead paint hazards. Applying this approach to Uganda, a number of measures meet this requirement of ideally benefiting all individuals irrespective of their resources and behaviors.[83-85] This study first strongly recommends the improvement of road infrastructure which includes more paved roads, physical separation of pedestrians and bicyclists from motorized transport through the provision of walkways, traffic signals at junctions, safe and raised pedestrian crossings, speed bumps or rumble strips, median barriers to prevent overtaking and to eliminate head-on crashes, better highlighting of road hazards, advisory speed limits at sharp bends, and systematic removal of roadside hazards such as trees. A second set of measures that should benefit all socioeconomic groups are related to traffic legislation and regulation, such as the police control of speed and drunk-driving, mandatory use of motorcycle helmets, mandatory use of seat belts and child restraints, and a compulsory law for the use of daytime running motorcycle headlights. Finally, Uganda must invest in a mass transit system to ensure safer modes of road travel.

This study has also identified a number of vulnerable groups. First, as understood and supported by many others, injury prevention should more heavily target males, particularly for RTIs. Second, while poverty-reduction programs have targeted female-headed households in the past, understanding the challenges of and needs for these households should be taken into account when designing community-based injury prevention programs. Third, this study draws attention to the susceptibility of older adults to injuries and calls for greater investment in injury treatment and rehabilitation for what is already a vulnerable group. One strategy of particular interest is community-based rehabilitation (CBR) because it operates within community development and is implemented through joint efforts of people with disabilities themselves, families, organizations, and relevant government and non-governmental staekholders.[86]

Finally, this paper offers recommendations to stimulate future research about socioeconomic disparities of injuries. First, the survey should continue to be implemented over time to see how the relationships between injury and socioeconomic status change, particularly in the context of urbanization and economic growth. Even in rural areas, urbanization should be explored through a scale-based measure of urbanicity.[59] Second, future surveys should collect data on education and consumption, as this is generally accepted as an accurate and direct measure of household socioeconomic status.[30] Third, the survey should implemented closer to the date when the socioeconomic data are collected. This will aid in achieving data completeness, enable a more thorough exploration of injuries and socioeconomic status in urban areas, and allow for the determination of variation in injury incidence across wealth quintiles through the construction of concentration curves and indices.[87]

A follow-up study should determine how injury risk factors vary by socioeconomic status. And while injury differences by sex are clear, what remains unclear is the extent to which these differences can be explained by male-dominated opportunities, occupations, and societal roles. Follow-up surveys should thus collect data on employment and occupation data from all working-age individuals at risk of an injury. Approaches to understanding the male burden of injuries can also be informed by the ways in which research on HIV/AIDS, sexually transmitted illnesses, and interpersonal violence in sub-Saharan Africa have increasingly examined how socially constructed gender differences and concepts such as masculinity influence men's risky behaviors and vulnerability to death and disease.[88-96] Female headed households should be explored to see how their experiences and challenges compare to their male counterparts and to help identify the effect modifiers of the relationship between household head sex and the risk for injuries. Given the establishment of the IM-DSS and its regular, on-going data collection, there is a promising opportunity to build upon this research.

References

1. GBD Mortality, Causes of Death Collaborators. Global, regional, and national age–sex specific all-cause and cause-specific mortality for 240 causes of death, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *The Lancet.*385(9963):117-171.
2. Institute for Health Metrics and Evaluation (IHME). GBD Compare. 2015; http://vizhub.healthdata.org/gbd-compare. . Accessed November 5, 2015.
3. Global Road Safety Facility; The World Bank and Institute for Health Metrics and Evaluation. *Transport for Health: The Global Burden of Disease from Motorized Road Transport.* Sealttle, WA2014.
4. Laflamme L, Burrows S, Hasselberg M. *Socioeconomic Differences in Injury Risks: A Review of Findings and A Discussion of Ptoential Countermeasures.* Copenhagen, Denmark: World Health Organization Europe; January 2009.
5. Mueller CW, Parcel TL. Measures of socioeconomic status: Alternatives and recommendations. *Child Development.* 1981:13-30.
6. Miech RA, Hauser RM. Socioeconomic status and health at midlife: a comparison of educational attainment with occupation-based indicators. *Annals of Epidemiology.* 2001;11(2):75-84.
7. Sen A. *Development as freedom.* Oxford ; New York: Oxford University Press; 2001.
8. Bates LM, Schuler SR, Islam F, Islam K. Socioeconomic factors and processes associated with domestic violence in rural Bangladesh. *Int Fam Plan Perspect.* 2004;30(4):190-199.
9. Ellsberg MC, Pena R, Herrera A, Liljestrand J, Winkvist A. Wife abuse among women of childbearing age in Nicaragua. *Am J Public Health.* 1999;89(2):241-244.
10. Karaoglu L, Celbis O, Ercan C, et al. Physical, emotional and sexual violence during pregnancy in Malatya, Turkey. *Eur J Public Health.* 2006;16(2):149-156.
11. Burrows S, Laflamme L. Living circumstances of suicide mortality in a South African city: an ecological study of differences across race groups and sexes. *Suicide & life-threatening behavior.* 2005;35(5):592-603.
12. Toros F, Bilgin NG, Sasmaz T, Bugdayci R, Camdeviren H. Suicide attempts and risk factors among children and adolescents. *Yonsei medical journal.* 2004;45(3):367-374.
13. Kinyanda E, Wamala D, Musisi S, Hjelmeland H. Suicide in urban Kampala, Uganda: a preliminary exploration. *African health sciences.* 2011;11(2):219-227.
14. Donroe J, Gilman RH, Brugge D, Mwamburi M, Moore DA. Falls, poisonings, burns, and road traffic injuries in urban Peruvian children and adolescents: a community based study. *Inj Prev.* 2009;15(6):390-396.
15. Lin T, Li N, Du W, Song X, Zheng X. Road traffic disability in China: prevalence and socio-demographic disparities. *Journal of public health.* 2013;35(4):541-547.
16. Delgado J, Ramirez-Cardich ME, Gilman RH, et al. Risk factors for burns in children: crowding, poverty, and poor maternal education. *Inj Prev.* 2002;8(1):38-41.

17. Abdalla S, Sudan Household Health Survey National Management T. Patterns of vulnerability to non-fatal injuries in Sudan: initial evidence from a national cross-sectional survey. *Inj Prev.* 2014;20(5):310-316.
18. Giashuddin SM, Rahman A, Rahman F, et al. Socioeconomic inequality in child injury in Bangladesh - implication for developing countries. *Int J Equity Health.* 2009;8:7.
19. Niekerk AV, Reimers A, Laflamme L. Area characteristics and determinants of hospitalised childhood burn injury: a study in the city of Cape Town. *Public Health.* 2006;120(2):115-124.
20. Doolan K, Ehrlich R, Myer L. Experience of violence and socioeconomic position in South Africa: a national study. *PloS one.* 2007;2(12):e1290.
21. Garrib A, Herbst AJ, Hosegood V, Newell ML. Injury mortality in rural South Africa 2000-2007: rates and associated factors. *Tropical medicine & international health : TM & IH.* 2011;16(4):439-446.
22. Commission on Social Determinants of Health. *Closing the gap in a generation: health equity through action on the social determinants of health. Final Report of the Commission on Social Determinants of Health.* Geneva: World Health Organization;2008.
23. *WHO Guide to Identifying the Economic Consequences of Disease and Injury.* Gevena, Switzerlind: Department of Health Systems Financing, Health Systems and Services, World Health Organization,;2009.
24. INTERNATIONAL DEVELOPMENT RESEARCH CENTRE. *POPULATION AND HEALTH IN DEVELOPING COUNTRIES: Population, Health, and Survival at INDEPTH Sites, Vol 1.* 2002.
25. Sankoh O, Byass P. The INDEPTH Network: filling vital gaps in global epidemiology. *International journal of epidemiology.* 2012;41(3):579-588.
26. Bachani AM, Galiwango E, Kadobera D, et al. A new screening instrument for disability in low-income and middle-income settings: application at the Iganga-Mayuge Demographic Surveillance System (IM-DSS), Uganda. *BMJ Open.* 2014;4(12):e005795.
27. Bachani AM, Hyder AA, Kadobera D, et al. Application of a new instrument to measure injuries and disability at the Iganga-Mayuge demographic surveillance system (im-dss), Uganda. *Injury prevention.* 2012;18(Suppl 1):A92-A92.
28. Sen G, Ostlin P, George A. *Unequal, Unfair, Ineffective, and Inefficient Gender Inequity in Health: Why it exists and how we can change it.* Women and Gender Equity Knowledge NEtwork;2007.
29. Carter M, May J. One Kind of Freedom: Poverty Dynamics in Post-Apartheid South Africa. *World Development.* 2001;29(12):1987-2006.
30. Filmer D, Pritchett LH. Estimating wealth effects without expenditure data--or tears: an application to educational enrollments in states of India. *Demography.* 2001;38(1):115-132.
31. Kolenikov S, Angeles G. The use of discrete data in PCA: theory, simulations, and applications to socioeconomic indices. *Chapel Hill: Carolina Population Center, University of North Carolina.* 2004.
32. Vyas S, Kumaranayake L. Constructing socio-economic status indices: how to use principal components analysis. *Health policy and planning.* 2006;21(6):459-468.

33. Rutstein SO. The DHS Wealth Index: Approaches for rural and urban areas. 2008.
34. Little R. A and Rubin, DB (1987) Statistical Analysis with Missing Data. *John A. Wiley & Sons, Inc., New York.*
35. Peugh JL, Enders CK. Missing data in educational research: A review of reporting practices and suggestions for improvement. *Review of educational research.* 2004;74(4):525-556.
36. Galiwango E, Kasunumba N. Personal communication on rural household assets. 2014.
37. Ssewanyana S, Bategeka L. Chronic poverty and economic growth in Uganda: The role of markets. *Chronic Poverty Report.* 2007;8.
38. Uganda Bureau of Statistics. *2002 Uganda Population and Housing Census Analytical Report.* Kampala, Uganda October 2006.
39. Olsson U. Maximum likelihood estimation of the polychoric correlation coefficient. *Psychometrika.* 1979;44(4):443-460.
40. Pearson K. LIII. On lines and planes of closest fit to systems of points in space. *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science.* 1901;2(11):559-572.
41. Howe LD, Hargreaves JR, Huttly SR. Issues in the construction of wealth indices for the measurement of socio-economic position in low-income countries. *Emerg Themes Epidemiol.* 2008;5:3.
42. Browne M, Ortmann G, Hendriks SL. Developing a resilience indicator for food security monitoring and evaluation: Index construction and household classification for six African countries. *Agrekon.* 2014;53(3):31-56.
43. Montgomery MR, Gragnolati M, Burke KA, Paredes E. Measuring living standards with proxy variables. *Demography.* 2000;37(2):155-174.
44. Garenne M, Hohmann-Garenne S. A wealth index to screen high-risk families: application to Morocco. *J Health Popul Nutr.* 2003;21(3):235-242.
45. Pearson K. X. On the criterion that a given system of deviations from the probable in the case of a correlated system of variables is such that it can be reasonably supposed to have arisen from random sampling. *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science.* 1900;50(302):157-175.
46. Ulm K. Simple method to calculate the confidence interval of a standardized mortality ratio (SMR). *American journal of epidemiology.* 1990;131(2):373-375.
47. Hilbe JM. *Negative binomial regression.* Cambridge University Press; 2011.
48. Barbour AD, Holst L, Janson S. *Poisson approximation.* Clarendon Press Oxford; 1992.
49. Aldrich JH, Nelson FD. *Linear probability, logit, and probit models.* Vol 45: Sage; 1984.
50. Bradshaw D, Groenewald P, Laubscher R, et al. Initial burden of disease estimates for South Africa, 2000: original article. *South African Medical Journal.* 2003;93(9):p. 682-688.
51. Rogers W. Regression standard errors in clustered samples. *Stata technical bulletin.* 1994;3(13).
52. Graham JW, Hofer SM, Donaldson SI, MacKinnon DP, Schafer JL. Analysis with missing data in prevention research. *The science of prevention: Methodological advances from alcohol and substance abuse research.* 1997;1:325-366.

53. Schafer JL. Multiple imputation: a primer. *Statistical methods in medical research.* 1999;8(1):3-15.
54. Schafer JL, Graham JW. Missing data: our view of the state of the art. *Psychological methods.* 2002;7(2):147.
55. White IR, Royston P, Wood AM. Multiple imputation using chained equations: Issues and guidance for practice. *Stat Med.* 2011;30(4):377-399.
56. Kobusingye O, Guwatudde D, Lett R. Injury patterns in rural and urban Uganda. *Inj Prev.* 2001;7(1):46-50.
57. Uchida H, Nelson A. Agglomeration index: towards a new measure of urban concentration. 2009.
58. Mukwaya P, Bamutaze Y, Mugarura S, Benson T. Rural-urban transformation in Uganda. Paper presented at: IFPRI-University of Ghana Understanding Economic Transformation in Sub-Saharan Africa Conference, Accra, Ghana, May2011.
59. Riha J, Karabarinde A, Ssenyomo G, et al. Urbanicity and lifestyle risk factors for cardiometabolic diseases in rural Uganda: a cross-sectional study. *PLoS medicine.* 2014;11(7):e1001683.
60. Novak NL, Allender S, Scarborough P, West D. The development and validation of an urbanicity scale in a multi-country study. *BMC Public Health.* 2012;12:530.
61. Nantulya VM, Reich MR. Equity dimensions of road traffic injuries in low- and middle-income countries. *Injury control and safety promotion.* 2003;10(1-2):13-20.
62. Kobusingye OC, Lett RR. Hospital-based trauma registries in Uganda. *J Trauma.* 2000;48(3):498-502.
63. Institute for Health Metrics and Evaluation. Global Burden of Disease Study 2010 (GBD 2010) Data Downloads. 2015.
64. Ae-Ngibise KA, Masanja H, Kellerman R, Owusu-Agyei S. Risk factors for injury mortality in rural Tanzania: a secondary data analysis. *BMJ Open.* 2012;2(6).
65. Twinomuhangi R, Buliung RN, Nakitto MT, Lett R. Application of geographic information systems methodology to injury surveillance in Uganda. *International Research Journal of Medicine and Medical Sciences.* 2014;2(2):20-39.
66. Bryceson DF, Howe J. Rural household transport in Africa: Reducing the burden on women? *World development.* 1993;21(11):1715-1728.
67. Porter G. 'I think a woman who travels a lot is befriending other men and that's why she travels': mobility constraints and their implications for rural women and girls in sub-Saharan Africa. *Gender, place and culture.* 2011;18(01):65-81.
68. Dungumaro EW. Gender differentials in household structure and socioeconomic characteristics in South Africa. *Journal of Comparative Family Studies.* 2008:429-451.
69. Goebel A, Dodson B, Hill T. Urban advantage or urban penalty? A case study of female-headed households in a South African city. *Health & place.* 2010;16(3):573-580.
70. Rosenhouse Persson S. *Identifying the poor: is headship a useful concept?* : World Bank; 1989.

71. Kossoudji S, Mueller E. The economic and demographic status of female-headed households in rural Botswana. *Economic Development and Cultural Change.* 1983:831-859.
72. Appleton S. Women-headed households and household welfare: An empirical deconstruction for Uganda. *World Development.* 1996;24(12):1811-1827.
73. Link BG, Phelan J. Social conditions as fundamental causes of disease. *Journal of health and social behavior.* 1995;Spec No:80-94.
74. Bishai D, Hyder AA, Ghaffar A, Morrow RH, Kobusingye O. Rates of public investment for road safety in developing countries: case studies of Uganda and Pakistan. *Health policy and planning.* 2003;18(2):232-235.
75. Bishai D, Johns B, Nair D, et al. The cost-effectiveness of supplementary immunization activities for measles: a stochastic model for Uganda. *The Journal of infectious diseases.* 2011;204 Suppl 1:S107-115.
76. Bachoo S, Bhagwanjee A, Govender K. The influence of anger, impulsivity, sensation seeking and driver attitudes on risky driving behaviour among post-graduate university students in Durban, South Africa. *Accident; analysis and prevention.* 2013;55:67-76.
77. Naci H, Chisholm D, Baker TD. Distribution of road traffic deaths by road user group: a global comparison. *Inj Prev.* 2009;15(1):55-59.
78. Nantulya VM, Muli-Musiime F. Kenya: Uncovering the social determinants of road traffic accidents. *Challenging inequities in health: from ethics to action.* 2001:211-225.
79. Mock C, Acheampong F, Adjei S, Koepsell T. The effect of recall on estimation of incidence rates for injury in Ghana. *International journal of epidemiology.* 1999;28(4):750-755.
80. McKenzie DJ. Measuring inequality with asset indicators. *Journal of Population Economics.* 2005;18(2):229-260.
81. Somi MF, Butler JR, Vahid F, Njau JD, Kachur SP, Abdulla S. Use of proxy measures in estimating socioeconomic inequalities in malaria prevalence. *Tropical Medicine & International Health.* 2008;13(3):354-364.
82. Phelan JC, Link BG, Tehranifar P. Social conditions as fundamental causes of health inequalities: theory, evidence, and policy implications. *Journal of health and social behavior.* 2010;51 Suppl:S28-40.
83. Lagarde E. Road traffic injury is an escalating burden in Africa and deserves proportionate research efforts. *PLoS medicine.* 2007;4(6):e170.
84. Ameratunga S, Hijar M, Norton R. Road-traffic injuries: confronting disparities to address a global-health problem. *Lancet.* 2006;367(9521):1533-1540.
85. Mohan D. *Road traffic injury prevention training manual.* World Health Organization; 2006.
86. Organization WH. CBR: A Strategy for Rehabilitation, Equalization of Opportunities, Poverty Reduction and, Social Inclusion of People With Disabilities. 2004.
87. Kakwani N, Wagstaff A, van Doorslaer E. Socioeconomic Inequalities in Health: Measurement, Computation, and Statistical Inference. *Journal of Econometrics.* 1997;77(1):87-104.

88. Izugbara CO. Masculinity scripts and abstinence-related beliefs of rural Nigerian male youth. *Journal of sex research.* 2008;45(3):262-276.
89. Harrison A, O'Sullivan LF, Hoffman S, Dolezal C, Morrell R. Gender role and relationship norms among young adults in South Africa: measuring the context of masculinity and HIV risk. *Journal of urban health : bulletin of the New York Academy of Medicine.* 2006;83(4):709-722.
90. Shai NJ, Jewkes R, Nduna M, Dunkle K. Masculinities and condom use patterns among young rural South Africa men: a cross-sectional baseline survey. *BMC Public Health.* 2012;12:462.
91. Dunkle KL, Jewkes R, Nduna M, et al. Transactional sex with casual and main partners among young South African men in the rural Eastern Cape: prevalence, predictors, and associations with gender-based violence. *Soc Sci Med.* 2007;65(6):1235-1248.
92. Boileau C, Zunzunegui MV, Rashed S. Gender differences in unsafe sexual behavior among young people in urban Mali. *AIDS care.* 2009;21(8):1014-1024.
93. Campbell C. Migrancy, masculine identities and AIDS: The psychosocial context of HIV transmission on the South African gold mines. *Soc Sci Med.* 1997;45(2):273-281.
94. Brown J, Sorrell J, Raffaelli M. An exploratory study of constructions of masculinity, sexuality and HIV/AIDS in Namibia, Southern Africa. *Culture, health & sexuality.* 2005;7(6):585-598.
95. Jewkes R, Sikweyiya Y, Morrell R, Dunkle K. Gender inequitable masculinity and sexual entitlement in rape perpetration South Africa: findings of a cross-sectional study. *PloS one.* 2011;6(12):e29590.
96. Barker G, Ricardo C. *Young men and the construction of masculinity in sub-Saharan Africa: implications for HIV/AIDS, conflict, and violence.* World Bank Washington, DC; 2005.

TABLE 1. Select variables from IM-DSS core demographic data and socioeconomic data

Variable	Response examples
Demographic	
Name of new born child	Qualitative
Name of deceased	Qualitative
Age of deceased	Numeric
Sex of usual household resident	Female/male
Year of birth of usual household resident	Numeric
Marital status of resident	Single, married, separated/divorced, co-habit, widowed
Names of persons who usually live in the household	Qualitative
Relationship of usual residents to the household head	Household head, wife, child, parent, grandparent, sister, uncle, not related
Did usual resident sleep in household last night	Yes/no
Did usual resident, who did not sleep in household last night, leave the household less than four months ago	Yes/no
Reason for individual's change in residence	Family related, security related, housing related, job related, cost related, education related
Relationship between household in-migrant and household head	Household head, wife, child, parent, grandparent, sister, uncle, not related
Sex of household in-migrant	Female/male
Basic reason for household in-migration	Build or form a new household Join an existing household
Reason for household in-migration	Family related, security related, housing related, job related, cost related, education related
Socioeconomic	
Formal employment of the head of household	Agriculture, trade, formal employment, laborer (wage earner), remittances, fishing, other
Occupation of the head of household	Shop/business, bodaboda/taxi, professional, farmer/agriculture, market vender, laborer (wage), mechanical work, other
Main source of drinking water	Taps, tanks, piped water into residence/compound/plot, well on residence/plot, unprotected spring, borehole
Type of dwelling	Independent house, basement, shared house, hut
Main roof material	Grass thatched, plastic sheet, carbonated sheets, wood/timber, metal sheets, iron sheets, tiles, cement, other
Total number of rooms	Quantitative
Owns cattle	Yes/no

Table 2. Assets selected for the asset index as a measure of household wealth

Asset variable	Type of Asset Index ("X" indicates inclusion of asset)		
	Principal Components Analysis Type of Correlation		Simple Sum of Assets
	Polychoric	Pearson's	
Material			
Roof	X		X
Wall	X	X	X
Floor	X	X	X
Total number			
Rooms	X		X
Sleeping rooms	X	X	X
Main source			
Light	X		X
Toilet			
Drinking water			
Garbage disposal			
Availability			
Shutters			
Handwashing facility			
Owns			
Land			
Mattress	X		X
Table	X		X
Bednet	X		X
Gas or electric cooker			
Kerosene stove	X		X
Charcoal iron	X	X	X
Electric iron	X		X
Television set	X		X
Radio	X	X	X
Mobile phone	X		X
Stereo	X		X
Phone			
Camera	X		X
Motorcycle	X		X
Bicycle	X	X	X
Car			
Refrigerator	X		X
Sewing machine	X	X	X
Panga	X		X
Wheelbarrow	X	X	X
Plough	X		X
Axe	X		X
Cattle	X		X
Sheep	X		X
Goat	X		X
Chicken	X		X
Pig			

Quantity currently in storage		
Maize		
Beans		
Millet		
Groundnuts		
Rice		
Cassava		
Stores food	X	X

Table 3. Recoding categorical asset variables for wealth index based on simple sum of assets

	Asset variable	Variable Coding for Asset Index: Principal Components Analysis	Variable Coding for Asset Index: Simple Sum of Assets
Material			
Roof	Grass, thatched, or plastic	1	0
	Wood or timber	2	
	Carbonated, metal or iron sheets	3	1
	Asbestos, tiles, or cement	4	
Wall	Mud, poles, or thatched	1	0
	Iron, carbonated, or metal sheets or unburnt bricks	2	
	Burnt bricks or cement blocks	3	1
	Wood or timber	4	
Floor	Earth or earth and dung	1	0
	Sand or gravel	2	
	Cement or wood planks	3	1
Total number			
Rooms	One	1	0
	Two	2	
	Three to ten	3	1
	Eleven or more	4	
Sleeping rooms	One	1	0
	Two	2	
	Three to ten	3	1
	Eleven or more	4	
Main source of light			
	Firewood	1	0
	Paraffin or wax candle	2	
	Paraffin or kerosene lantern	3	1
	Solar or electricity	4	

Table 4. Sample characteristics in the IM-DSS, 2009-2010 (n=59,248)

	Column % (No)
Sex	
Female	53.9 (31,950)
Male	46.1 (27,298)
Age (years)	
Under 5	14.4 (8,527)
5 to <15	34 (20,116)
15 to <30	28 (16,562)
30 to <45	12.9 (7,669)
45 to <60	6.1 (3,586)
Over 60	4.7 (2,788)
Relationship to household head	
Child, grandchild, or stepchild	64.2 (38,038)
Household head	15.7 (9,323)
Wife	11.6 (6,867)
Niece or nephew	2.2 (1,318)
Not related	1.8 (1,051)
Other	4.5 (2,651)
Household head sex	
Female	16.6 (9,829)
Male	83.4 (49,419)
Household head occupation†	
Professional	6 (3,002)
Shop/business	18.2 (9,100)
Bodaboda/Taxi	6.3 (3,131)
Laborer (wage)	15.7 (7,846)
Farmer/agriculture	44.5 (22,242)
Not employed	4.7 (2,357)
Other	4.7 (2,347)
Data collection round	
2009 only	6.2 (3,694)
2010 only	7.5 (4,473)
Both 2009 and 2010	86.2 (51,081)
Area development	
Peri-urban	20.9 (15,615)
Rural	79.1 (59,143)
Principal components analysis-based wealth quintile	
Highest	26.9 (13,313)
Second highest	23.6 (11,646)
Middle	20.2 (10,003)
Second lowest	16.9 (8,356)
Lowest	12.4 (6,133)
Simple sum of assets-based wealth quintile	
Highest	19.7 (9,750)
Second highest	29.7 (14,684)
Middle	19.6 (9,700)
Second lowest	14.3 (7,065)

	Column % (No)
Lowest	16.7 (8,252)
Injury case	
Not injured	98.7 (58,486)
Injured	1.3 (762)
Specific type of injury	
Not injured	98.7 (58,484)
RTI	0.5 (324)
Unintentional fall	0.3 (181)
Burn	0.1 (59)
Blunt injury	0.1 (60)
Other	0.2 (140)
Type of road user among the RTIs (n=324)	
Bicycle	62.3 (202)
Motor vehicle	26.5 (86)
Pedestrian	11.1 (36)

TABLE 5. Household head characteristics (n=9,323)

	Column % (No.)
Sex	
Female	21 (1,962)
Male	79 (7,361)
Age (years)	
Under 15	0.03 (3)
15 to <30	13 (1,209)
30 to <45	41.3 (3,852)
45 to <60	24 (2,240)
Over 60	21.6 (2,018)
Marital status*	
Married	68.3 (5181)
Widowed	12.6 (956)
Separated	7.2 (545)
Live-in partner	6 (457)
Never married	4.4 (330)
Divorced	1.5 (115)
Occupation[†]	
Professional	5.3 (394)
Shop/business	16.9 (1,254)
Bodaboda/Taxi	6.4 (476)
Laborer (wage)	17.2 (1,280)
Farmer/agriculture	43 (3,194)
Not employed	6.8 (507)
Other	4.3 (323)
Injury case	
Not injured	96.8 (9,028)
Injured	3.2 (295)
Specific type of injury	
Not injured	97.3 (12,157)
RTI	1.5 (185)
Unintentional fall	0.6 (72)
Burn	0.1 (10)
Blunt injury	0.2 (21)
Other	0.4 (49)

* Smaller sample sizes are due to missing data.

TABLE 6. Chi square analyses of household head characteristics by sex in the IM-DSS, 2009-2010 (n=9,323)

	Sex Column % (No.) Female	Male	Pearson χ2 statistic (p-value)
Age (years)			
Under 30	10 (240)	14.1 (973)	618.3 (<0.0001)
30 to <45	26.1 (627)	46.6 (3225)	
45 to <60	25.8 (620)	23.4 (1620)	
Over 60	38.2 (918)	15.9 (1100)	
Marital status			
Married	28.1 (517)	86.2 (4664)	3123.4 (<0.0001)
Living with partner	2.8 (52)	7.5 (405)	
Widowed, divorced, separated, or never married	69.1 (1272)	6.4 (344)	
Occupation			
Professional	3.1 (57)	6 (337)	741.3 (<0.0001)
Shop/business	13.7 (254)	17.9 (1000)	
Bodaboda/Taxi	1.3 (24)	8.1 (452)	
Laborer (wage)	8.1 (149)	20.3 (1131)	
Farmer/agriculture	53.1 (981)	39.7 (2213)	
Not employed	17.6 (325)	3.3 (182)	
Other	3.1 (58)	4.7 (265)	

TABLE 7. Injury incidence rates in the rural sub-sample of the IM-DSS, 2009-2010) (n=59,248)

	Number		Rate per 1,000 person-years	
	Injuries	Person-years	Estimate	(95% CI)
Total				
	762	36776.3	20.72	(19.3, 22.24)
Sex				
Female	282	19231.7	14.66	(13.05, 16.48)
Male	480	17544.7	27.36	(25.02, 29.92)
Age (years)				
Under 5	57	4852.7	11.75	(9.06, 15.23)
5 to <15	177	12669.3	13.97	(12.06, 16.19)
15 to <30	182	10217	17.81	(15.41, 20.6)
30 to <45	168	4912.7	34.2	(29.4, 39.78)
45 to <60	98	2338	41.92	(34.39, 51.09)
Over 60	80	1786.7	44.78	(35.97, 55.75)
Household head sex				
Female	135	5999.7	22.5	(19.01, 26.64)
Male	627	30776.7	20.37	(18.84, 22.03)
Household head occupation				
Professional	37	1901	19.46	(14.1, 26.86)
Shop/business	107	5698.3	18.78	(15.54, 22.7)
Bodaboda/Taxi	59	1969.7	29.95	(23.21, 38.66)
Laborer (wage)	118	4917	24	(20.04, 28.74)
Farmer/ agriculture	288	13948	20.65	(18.4, 23.18)
Not employed	39	1446.7	26.96	(19.7, 36.9)
Other	27	1488.7	18.14	(12.44, 26.45)
Wealth quintile (PCA-based asset index)				
Highest	173	8414.3	20.56	(17.71, 23.86)
Second highest	171	7327.7	23.34	(20.09, 27.11)
Middle	115	6267.7	18.35	(15.28, 22.03)
Second lowest	111	5220.7	21.26	(17.65, 25.61)
Lowest	95	3776.7	25.15	(20.57, 30.76)

TABLE 8. Incidence rate ratios in the rural sub-sample of the IM-DSS, 2009-2010 (n=59,248)

	Injury rate ratio (95% CI) p-value		
	Model 1 (PCA-based asset index)		Model 2 (Simple sum-based asset index)
	Unadjusted	Adjusted	Adjusted
Sex			
Female	1.0	1.0	1.0
Male	1.86 (1.64, 2.12) <0.0001	1.93 (1.67, 2.24) <0.0001	1.93 (1.66, 2.24) <0.0001
Age (years)			
Under 5	1.0	1.0	1.0
5 to <15	1.19 (0.87, 1.64) 0.281	1.19 (0.88, 1.6) 0.253	1.19 (0.89, 1.61) 0.241
15 to <30	1.52 (1.09, 2.12) 0.014	1.53 (1.13, 2.06) 0.005	1.55 (1.15, 2.08) 0.004
30 to <45	2.90 (2.04, 4.11) <0.0001	2.93 (2.17, 3.95) <0.0001	2.94 (2.18, 3.96) <0.0001
45 to <60	3.57 (2.67, 4.78) <0.0001	3.67 (2.65, 5.08) <0.0001	3.7 (2.67, 5.13) <0.0001
Over 60	3.81 (2.75, 5.28) <0.0001	3.99 (2.84, 5.62) <0.0001	4.02 (2.86, 5.67) <0.0001
Household head sex			
Female	1.0	1.0	1.0
Male	0.90 (0.75, 1.09) 0.298	0.79 (0.65, 0.97) 0.022	0.8 (0.66, 0.97) 0.026
Household head occupation			
Professional	1.0	1.0	1.0
Shop/business	0.94 (0.68, 1.28) 0.678	1.03 (0.71, 1.5) 0.883	0.99 (0.68, 1.43) 0.941
Bodaboda/Taxi	1.52 (1.05, 2.19) 0.027	1.79 (1.18, 2.72) 0.006	1.68 (1.11, 2.55) 0.014
Laborer (wage)	1.22 (0.87, 1.71) 0.242	1.29 (0.89, 1.87) 0.177	1.21 (0.84, 1.75) 0.303
Farmer/ agriculture	1.04 (0.75, 1.44) 0.812	1.04 (0.73, 1.47) 0.846	0.97 (0.69, 1.38) 0.881

	Injury rate ratio (95% CI) p-value		
	Model 1 (PCA-based asset index)		Model 2 (Simple sum-based asset index)
Not employed	1.32 (0.81, 2.15) 0.265	1.12 (0.7, 1.8) 0.632	1.05 (0.66, 1.68) 0.84
Other	0.90 (0.56, 1.45) 0.672	0.94 (0.57, 1.55) 0.797	0.89 (0.54, 1.47) 0.662
Wealth quintile			
Highest	1.0	1.0	1.0
Second highest	1.05 (0.84, 1.32) 0.664	1.11 (0.9, 1.37) 0.333	1.3 (1.03, 1.63) 0.025
Middle	0.99 (0.81, 1.20) 0.894	0.88 (0.69, 1.13) 0.31	1.13 (0.86, 1.47) 0.383
Second lowest	0.91 (0.72, 1.14) 0.410	0.98 (0.76, 1.25) 0.865	1.11 (0.84, 1.48) 0.466
Lowest	1.04 (0.80, 1.35) 0.790	1.05 (0.8, 1.38) 0.706	1.23 (0.93, 1.62) 0.147

Table 9. Odds ratios for injury in the rural IM-DSS, 2009-2010 (n=59,143)

	Odds ratio (95% CI) p-value		
	Model 1 PCA-based asset index		Model 2 Simple sum-based asset index
	Unadjusted	Adjusted	Adjusted
Sex			
Female	1.0	1.0	1.0
Male	2.01 (1.76, 2.29) <0.0001	1.92 (1.67, 2.2) <0.0001	1.91 (1.66, 2.2) <0.0001
Age (years)			
Under 5	1.0	1.0	1.0
5 to <15	1.32 (0.96, 1.82) 0.089	1.15 (0.84, 1.58) 0.39	1.15 (0.84, 1.58) 0.374
15 to <30	1.65 (1.18, 2.31) 0.003	1.49 (1.06, 2.08) 0.021	1.5 (1.07, 2.1) 0.018
30 to <45	3.31 (2.32, 4.72) <0.0001	2.86 (2.02, 4.06) <0.0001	2.87 (2.03, 4.07) <0.0001
45 to <60	4.18 (3.11, 5.61) <0.0001	3.58 (2.69, 4.77) <0.0001	3.61 (2.71, 4.81) <0.0001
Over 60	4.39 (3.14, 6.12) <0.0001	3.9 (2.77, 5.48) <0.0001	3.93 (2.8, 5.51) <0.0001
Household head sex			
Female	1.0	1.0	1.0
Male	0.92 (0.76, 1.12) 0.407	0.79 (0.65, 0.97) 0.026	0.8 (0.65, 0.98) 0.028
Household head occupation			
Professional	1.0	1.0	1.0
Shop/business	0.95 (0.69, 1.30) 0.729	1.03 (0.74, 1.43) 0.878	0.99 (0.71, 1.37) 0.934
Bodaboda/Taxi	1.54 (1.07, 2.23) 0.021	1.76 (1.21, 2.56) 0.003	1.65 (1.13, 2.41) 0.009
Laborer (wage)	1.22 (0.87, 1.73) 0.252	1.29 (0.91, 1.85) 0.155	1.22 (0.85, 1.74) 0.277
Farmer/ agriculture	1.04 (0.76, 1.43) 0.791	1.05 (0.74, 1.48) 0.784	0.99 (0.7, 1.39) 0.951

Not employed	1.29 (0.78, 2.12) 0.324	1.16 (0.7, 1.91) 0.571	1.08 (0.65, 1.8) 0.754
Other	0.92 (0.56, 1.49) 0.726	0.94 (0.57, 1.54) 0.799	0.9 (0.54, 1.48) 0.672
Number of rounds surveyed			
One	1.0	1.0	1.0
Two	4.09 (2.84, 5.88) <0.0001	2.83 (1.98, 4.03) <0.0001	2.83 (1.98, 4.04) <0.0001
Wealth quintile			
Highest	1.0	1.0	1.0
Second highest	1.05 (0.84, 1.33) 0.647	1.11 (0.9, 1.37) 0.328	1.28 (1.02, 1.62) 0.036
Middle	0.99 (0.81, 1.21) 0.895	0.88 (0.71, 1.09) 0.236	1.11 (0.86, 1.44) 0.426
Second lowest	0.90 (0.71, 1.14) 0.381	0.97 (0.74, 1.26) 0.816	1.11 (0.88, 1.4) 0.37
Lowest	1.03 (0.78, 1.35) 0.856	1.04 (0.84, 1.3) 0.705	1.2 (0.94, 1.53) 0.143

TABLE 10. Road traffic injury incidence rates in rural IM-DSS, 2009-2010 (n=59,143)

	Number		Rate per 1,000 person-years (95% CI)	
	Injuries	Person-years	Estimate	(95% CI)
Total				
	324	36776.3	8.81	(7.9, 9.82)
Sex				
Female	46	5999.7	7.67	(5.74, 10.24)
Male	278	30776.7	9.03	(8.03, 10.16)
Age (years)				
Under 15	56	17522	3.2	(2.46, 4.15)
15 to <30	102	10217	9.98	(8.22, 12.12)
30 to <45	104	4912.7	21.17	(17.47, 25.66)
Over 45	62	4124.7	15.03	(11.72, 19.28)
Household head sex				
Female	46	5999.7	7.67	(5.74, 10.24)
Male	278	30776.7	9.03	(8.03, 10.16)
Household head occupation				
Professional or shop/business	69	7599.3	9.08	(7.17, 11.5)
Bodaboda/Taxi	36	1969.7	18.28	(13.18, 25.34)
Farmer/agriculture	119	13948	8.53	(7.13, 10.21)
Laborer, wage worker, or other	67	7852.3	8.53	(6.72, 10.84)
Wealth quintile				
Highest	84	8414.3	9.98	(8.06, 12.36)
Second highest	76	7327.7	10.37	(8.28, 12.99)
Middle	52	6267.7	8.3	(6.32, 10.89)
Second lowest	45	5220.7	8.62	(6.44, 11.55)
Lowest	30	3776.7	7.94	(5.55, 11.36)

TABLE 11. Road traffic injury incidence rate ratios in rural IM-DSS, 2009-2010 (n=59,143)

	Incidence rate ratio (95% CI) p-value		
	Model 1 PCA-based asset index		Model 2 Simple sum-based asset index
	Unadjusted	Adjusted	Adjusted
Sex			
Female	1.0	1.0	1.0
Male	2.99 (2.34, 3.82) <0.0001	3.03 (2.37, 3.89) <0.0001	3.03 (2.36, 3.89) <0.0001
Age (years)			
Under 15	1.0	1.0	1.0
15 to <30	3.12 (2.26, 4.32) <0.0001	3.16 (2.28, 4.4) <0.0001	3.21 (2.31, 4.45) <0.0001
30 to <45	6.62 (4.79, 9.16) <0.0001	6.63 (4.79, 9.16) <0.0001	6.59 (4.77, 9.11) <0.0001
Over 45	4.7 (3.28, 6.74) <0.0001	5.11 (3.55, 7.36) <0.0001	5.11 (3.55, 7.36) <0.0001
Household head sex			
Female	1.0	1.0	1.0
Male	1.18 (0.86, 1.61) 0.302	0.85 (0.61, 1.19) 0.351	0.88 (0.63, 1.23) 0.458
Household head occupation			
Professional or shop/business	1.0	1.0	1.0
Bodaboda/Taxi	2.02 (1.35, 3.02) 0.001	2.18 (1.45, 3.28) <0.0001	2.05 (1.38, 3.06) <0.0001
Farmer/ agriculture	0.93 (0.69, 1.26) 0.658	0.97 (0.71, 1.34) 0.871	0.92 (0.68, 1.26) 0.616
Laborer, wage worker, or other	0.93 (0.67, 1.3) 0.684	0.96 (0.68, 1.37) 0.84	0.91 (0.63, 1.29) 0.586
Wealth quintile			
Highest	1.0	1.0	1.0
Second highest	1.01 (0.74, 1.38) 0.947	1.05 (0.76, 1.43) 0.782	1.39 (0.99, 1.94) 0.057
Middle	0.84 (0.59, 1.19) 0.321	0.85 (0.6, 1.2) 0.362	1.12 (0.76, 1.66) 0.554
Second lowest	0.85	0.86	1.06

	Incidence rate ratio (95% CI) p-value		
	Model 1 PCA-based asset index		Model 2 Simple sum-based asset index
	Unadjusted	Adjusted	Adjusted
	(0.59, 1.2) 0.353	(0.6, 1.25) 0.428	(0.68, 1.63) 0.801
Lowest	0.77 (0.51, 1.17) 0.221	0.78 (0.5, 1.21) 0.264	1.16 (0.77, 1.77) 0.478

Table 12. Odds ratios for road traffic injury in the rural IM-DSS, 2009-2010 (n=59,143)

	Odds ratio (95% CI) p-value		
	Model 1 PCA-based asset index		Model 2 Simple sum-based asset index
	Unadjusted	Adjusted	Adjusted
Sex†			
Female	1.0	1.0	
Male	3.21 (2.34, 4.4) <0.0001	3.01 (2.15, 4.21) <0.0001	3 .00 (2.14, 4.21) <0.0001
Age (years)†			
Under 15	1.0	1.0	1.0
15 to <30	3.16 (2.31, 4.34) <0.0001	3.17 (2.29, 4.39) <0.0001	3.21 (2.32, 4.44) <0.0001
30 to <45	7.02 (4.98, 9.89) <0.0001	6.65 (4.68, 9.45) <0.0001	6.62 (4.65, 9.44) <0.0001
Over 45	5.32 (3.35, 8.47) <0.0001	5.09 (3.58, 7.23) <0.0001	5.09 (3.58, 7.22) <0.0001
Household head sex†			
Female	1.0	1.0	1.0
Male	1.2 (0.96, 1.51) 0.109	0.86 (0.65, 1.13) 0.275	0.88 (0.67, 1.16) 0.357
Household head occupation†			
Professional or shop/business	1.0	1.0	1.0
Bodaboda/Taxi	2.01 (1.35, 2.99) 0.001	2.17 (1.45, 3.26) <0.0001	2.08 (1.4, 3.1) 0
Farmer/ agriculture	0.93 (0.7, 1.25) 0.633	0.97 (0.72, 1.31) 0.861	0.92 (0.69, 1.24) 0.599
Laborer, wage worker, or other	0.93 (0.67, 1.29) 0.658	0.96 (0.67, 1.37) 0.809	0.91 (0.63, 1.3) 0.593
Number of rounds			
One	1.0	1.0	1.0
Two	5.06 (2.61, 9.78) <0.0001	2.76 (1.41, 5.4) 0.003	2.78 (1.42, 5.44) 0.003
Wealth quintile			
Highest	1.0	1.0	1.0
Second highest	1 (0.69, 1.45) 0.995	1.07 (0.75, 1.54) 0.7	1.4 (0.99, 1.96) 0.056
Middle	0.84	0.86	1.13

	Odds ratio (95% CI) p-value		
	Model 1 PCA-based asset index		Model 2 Simple sum-based asset index
	Unadjusted	Adjusted	Adjusted
	(0.57, 1.23) 0.366	(0.58, 1.28) 0.461	(0.77, 1.66) 0.542
Second lowest	0.83 (0.54, 1.27) 0.391	0.91 (0.59, 1.39) 0.654	1.07 (0.68, 1.67) 0.782
Lowest	0.75 (0.51, 1.11) 0.153	0.81 (0.53, 1.24) 0.327	1.16 (0.75, 1.81) 0.502

Table 13. Odds ratios for being in a motorized vehicle compared to being on a bicycle or being a pedestrian among those with an RTI in the rural IM-DSS, 2009-2010 (n=324)

	Odds ratio (95% CI) p-value		
	Model 1 PCA-based asset index		Model 2 Simple sum-based asset index
	Unadjusted	Adjusted	Adjusted
Sex			
Female	1.0	1.0	1.0
Male	1.29 (0.81, 2.07) 0.284	1.14 (0.67, 1.92) 0.634	1.12 (0.67, 1.87) 0.663
Age (years)			
Under 30	1.0	1.0	1.0
30 to <45	2.17 (1.29, 3.64) 0.003	2.01 (1.23, 3.28) 0.005	1.95 (1.21, 3.13) 0.006
Over 45	1.81 (0.96, 3.4) 0.066	2.16 (1.19, 3.91) 0.011	2.11 (1.17, 3.81) 0.013
Household head sex			
Female	1.0	1.0	1.0
Male	1.35 (0.68, 2.68) 0.383	1.11 (0.59, 2.11) 0.747	1.17 (0.6, 2.27) 0.65
Household head occupation			
Professional or shop/business	1.0	1.0	1.0
Bodaboda/Taxi	1.63 (0.63, 4.26) 0.316	1.43 (0.55, 3.74) 0.461	1.45 (0.59, 3.53) 0.419
Farmer/ agriculture	0.46 (0.22, 0.97) 0.04	0.42 (0.22, 0.8) 0.008	0.43 (0.22, 0.87) 0.019
Laborer, wage worker, or other	0.65 (0.31, 1.38) 0.262	0.57 (0.29, 1.13) 0.108	0.6 (0.31, 1.16) 0.131
Number of rounds			
One	1.0	1.0	1.0
Two	5.06 (2.61, 9.78) <0.0001	2.76 (1.41, 5.4) 0.003	2.78 (1.42, 5.44) 0.003
Wealth quintile			
Highest	1.0	1.0	1.0
Second highest	1.23 (0.57, 2.64) 0.599	1.47 (0.68, 3.17) 0.326	1.07 (0.54, 2.11) 0.849
Middle	0.82 (0.29, 2.33) 0.711	0.91 (0.31, 2.7) 0.867	1.08 (0.42, 2.8) 0.866

	Odds ratio (95% CI) p-value		
	Model 1 PCA-based asset index		Model 2 Simple sum-based asset index
	Unadjusted	Adjusted	Adjusted
Second lowest	1.2 (0.45, 3.2) 0.718	1.5 (0.55, 4.06) 0.425	1.18 (0.35, 3.93) 0.79
Lowest	1.58 (0.57, 4.37) 0.375	1.86 (0.67, 5.15) 0.23	1.39 (0.59, 3.28) 0.449

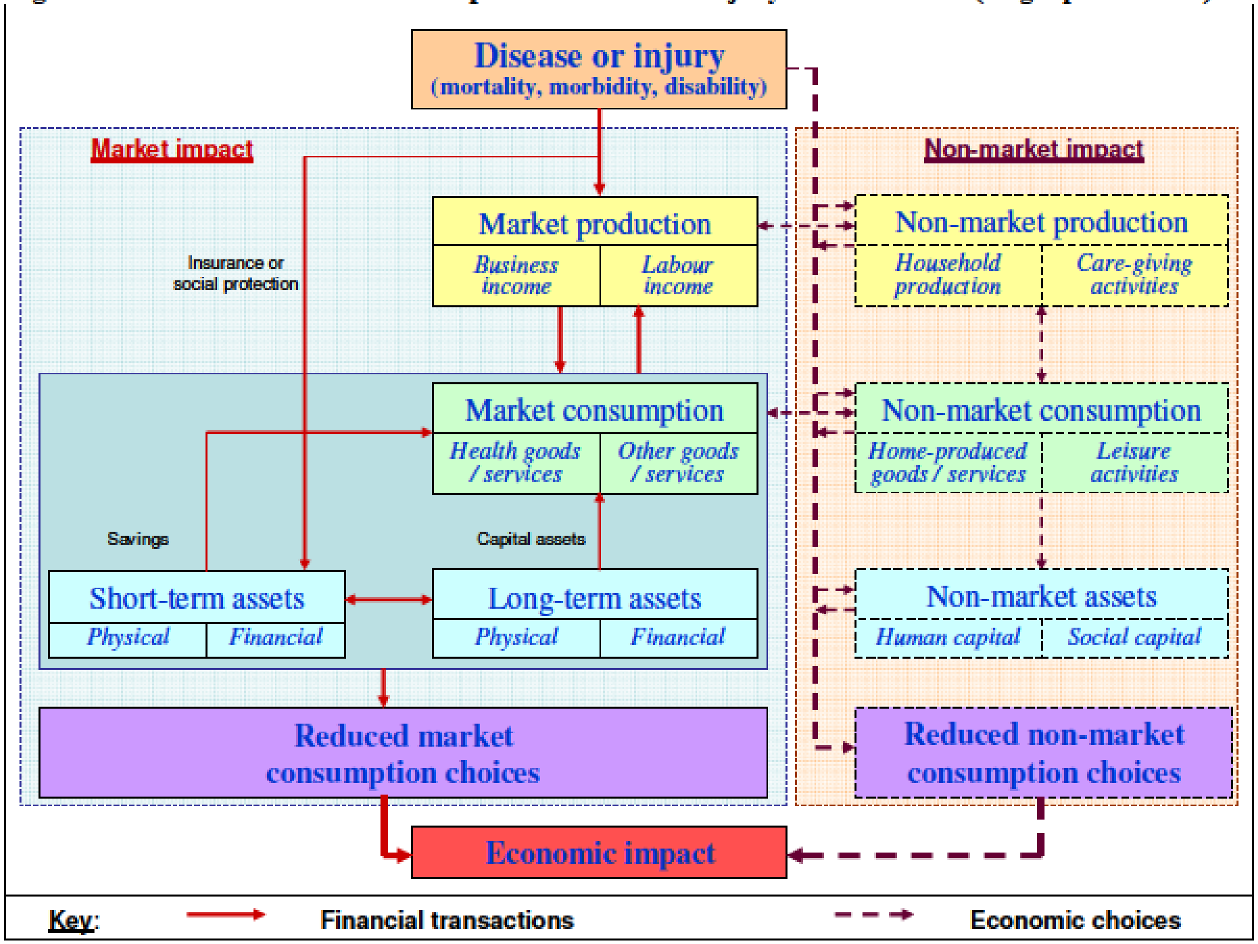
* Smaller sample sizes are due to missing data.

Table 14. Literature on injuries and socioeconomic status as measured by education or assets in low- and middle-income countries

Study	Region	Sample	Injury Outcome	Effect on Injury Risk By Indicator of Socioeconomic Status	
				Education	Household Assets
Abdalla 2013	Sudan	All household members	Non-fatal animal bits, burns, falls, interpersonal violence, mechanical, poisoning, RTIs	Compared to having a mother who did not attain education, having one who attained a higher level increased risk of mechanical, increased risk of animal bite leading to hospitalization, and decreased risk of poisoning	Belonging to a higher wealth tertile increased risk of RTI but decreased risk of interpersonal violence
Bates et al. 2004	Rural Bangladesh	Married women	Non-fatal interpersonal violence	Woman having more than five years of education decreases risk	
Burrows and LaFlamme 2005	Tshwane, South Africa	Blacks and whites 15 years and older	Suicide	As part of a factor analysis where low educational attainment decreased the level of "socioeconomic circumstances," lower levels of the factor decreased risk for whites, no association for blacks	
Delgado et al. 2002	Lima, Peru	Younger than 18 years	Non-fatal burns	Mother having less than high school education increased risk	
Doolan et al. 2007	South Africa	All household members	Non-fatal interpersonal violence		Compared to the poorest quintile, being in the wealthiest decreased risk
Donroe et al. 2009	Lima, Peru	Younger than 18 years	Non-fatal burns, falls, poisonings, and RTIs	Household head not completing high school increased risk of pedestrian RTI	
Ellsberg et al. 1999	Leon, Nicaragua	15 to 49 year old female	Non-fatal Interpersonal violence	No association for the either the wife's or the husband's educational attainment	
Forjuoh et al. 1995	Ashanti region, Ghana	0-5 year old children	Non-fatal burns	No association with whether or not mother received education	
Garrib et al. 2011	South Africa	All household members	Fatal all-cause injuries	No education decreased risk	Higher asset index scores increased risk only among men
Giashuddin et al. 2009	Bangladesh	1-4 year old	Fatal and non-fatal injuries, all causes		Belonging to a poor household increased risk,

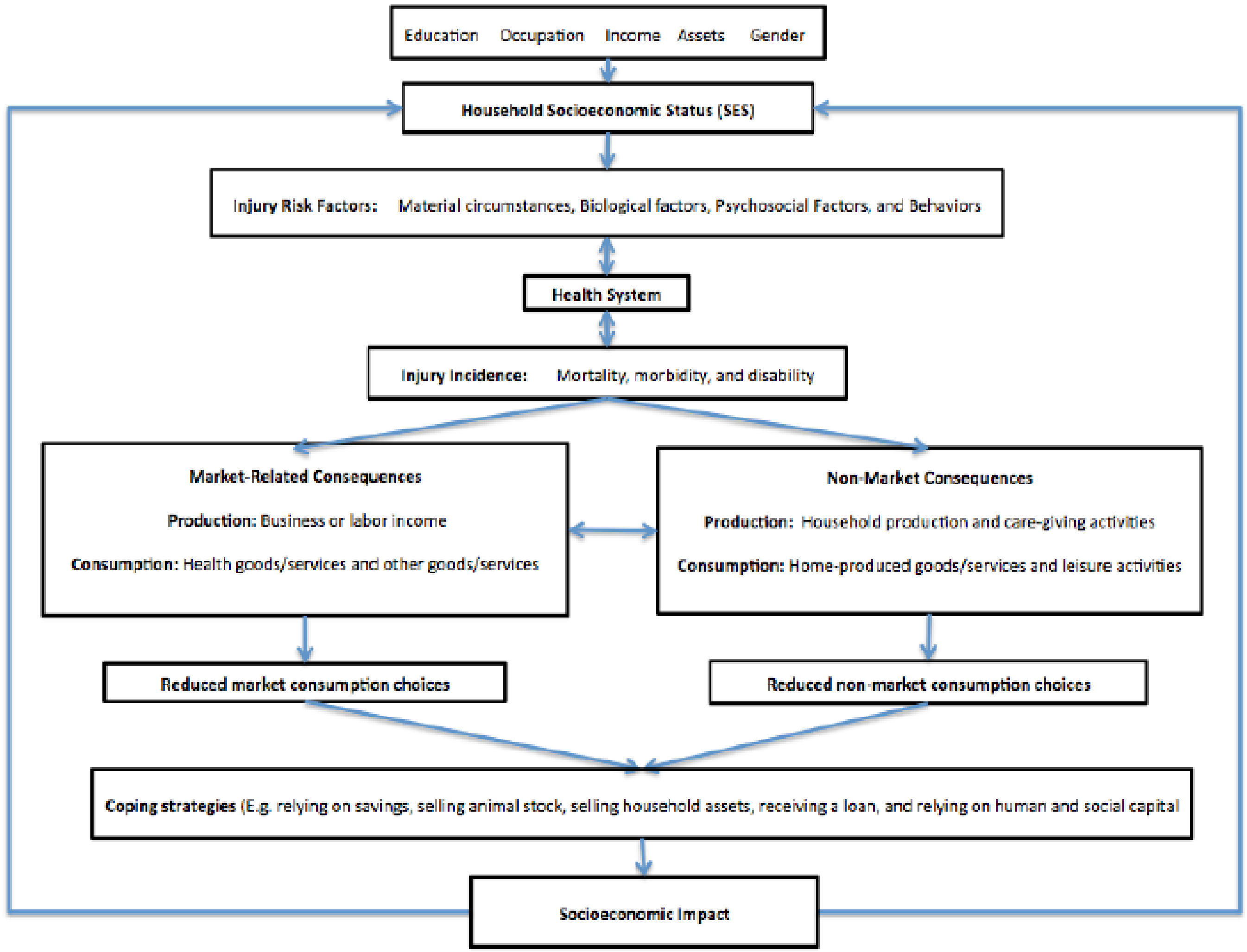
Study	Region	Sample	Injury Outcome	Effect on Injury Risk By Indicator of Socioeconomic Status	
				Education	**Household Assets**
		children			especially for drowning
Karaoglu et al 2005	Malatya, Turkey	Pregnant women	Non-fatal Interpersonal violence	Having a husband who is illiterate or attained less than eight years of education increased risk	
Kinyanda et al. 2003	Kampala, Uganda	15 years and older	Self-harm	Greater educational attainment Increased risk	
Toros et al. 2004	Mersin, Turkey	6th to 11th grade school children	Self-harm	Additional year of mother's or father's educational attainment decreased risk	
Van Niekerk et al 2006	Cape Town, South Africa	12 years and younger	Non-fatal, burns		Falling into the "poor" or "impoverished" housing condition categories increased risk

Figure 1. Financial and economic impacts of disease or injury on households (single period case)



Source: WHO Guide to Identifying the Economic Consequences of Disease and Injury. Gevena, Switzerlind: Department of Health Systems Financing, Health Systems and Services, World Health Organization, 2009.

Figure 2. Conceptual Framework For Research



Source: Author

Figure 3. Map of Uganda, showing the Iganga-Mayuge-Demographic Surveillance Site within the Iganga and Mayuge Districts

Figure 4. Frequency of raw total household asset count in the rural IM-DSS (n=7,335)

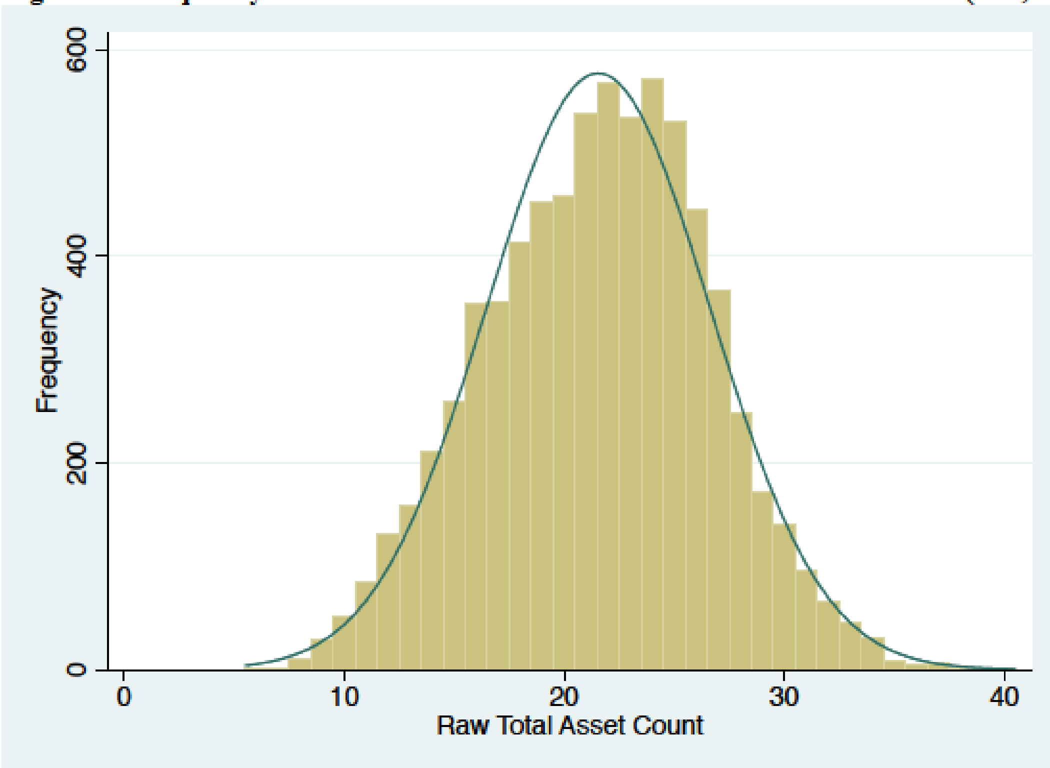


Figure 5. Percentage of variance explained by the firs four principal components of the polychoric PCA-based asset index

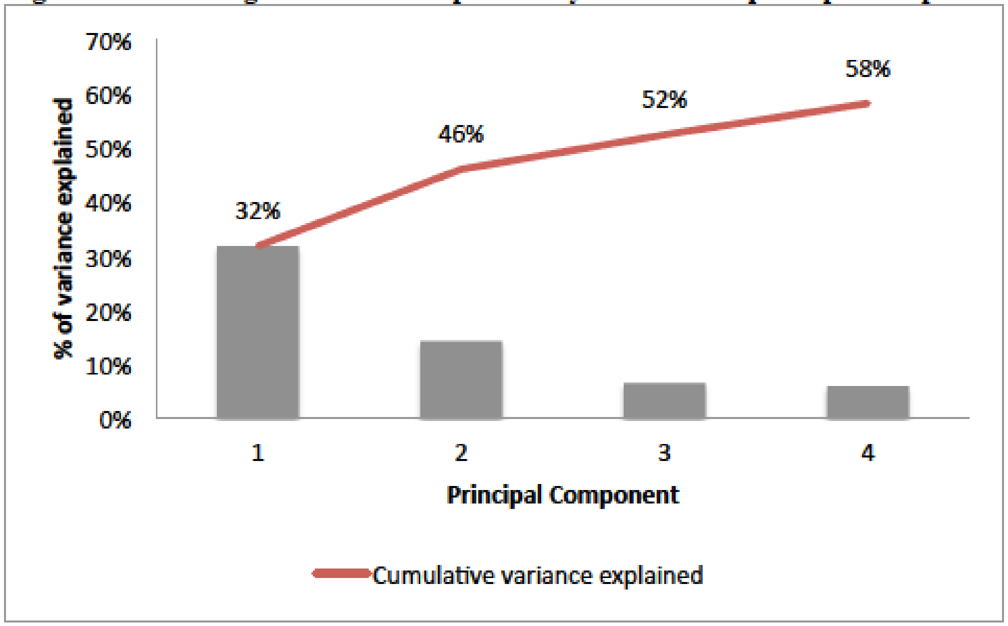


Figure 6. Percentage of variance explained by the firs four principal components of the Pearson correlation PCA-based asset index

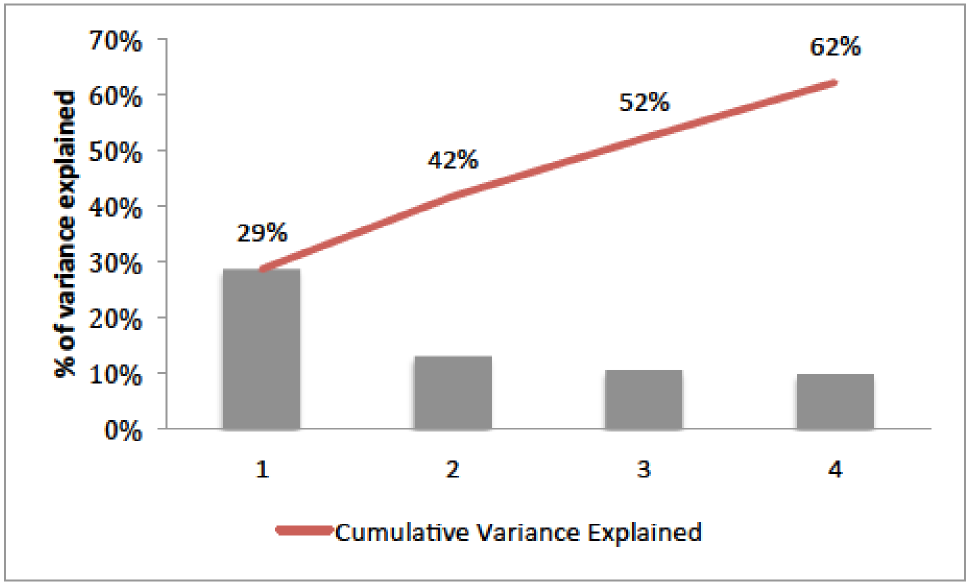
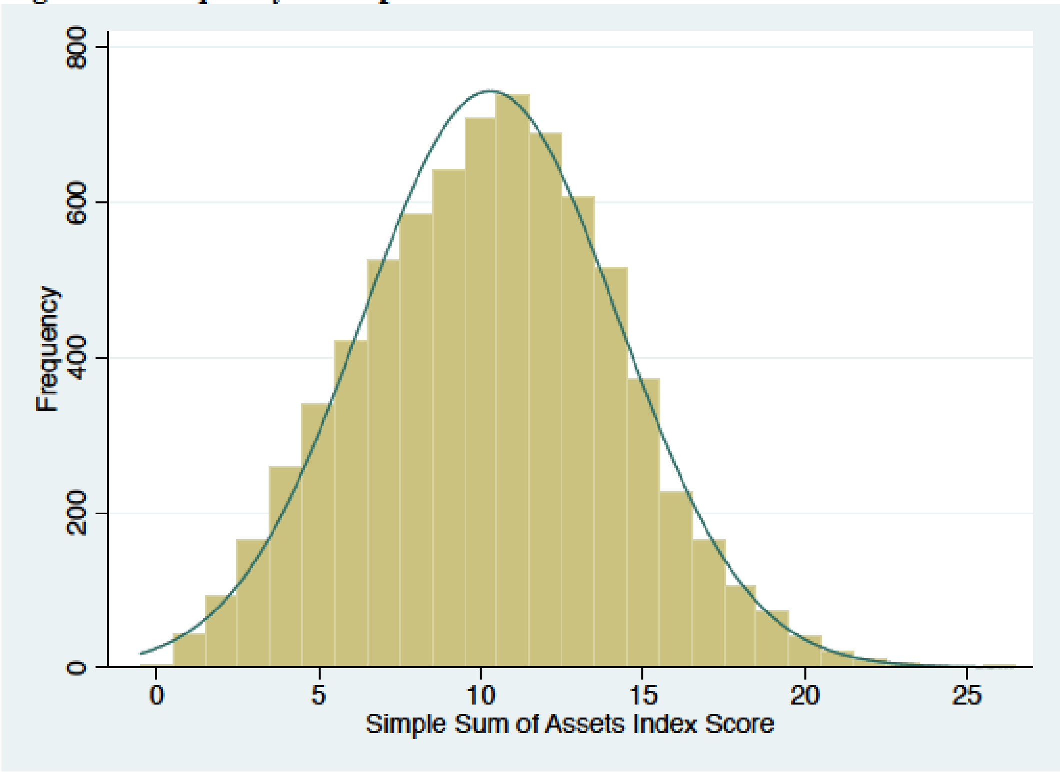


Figure 7. Frequency of simple sum of assets index score in the rural IM-DSS (n=7,355)



Paper Two:

Direct Socioeconomic Consequences of Injuries in a Demographic Surveillance Site

Abstract

In addition to great magnitude of the loss of mortality and morbidity due to global injuries, previous literature indicates that the injured faces direct socioeconomic consequences such as loss of money, time, employment, and productivity. However, evidence on these consequences, particularly those following an injury of any cause, in sub-Saharan countries such as Uganda has been limited to date. The Iganga-Mayuge Demographic Surveillance Site (IM-DSS) provides an opportunity to collect population-based data to inform national health policies, and the Johns Hopkins University International Injury Research Unit (JH-IIRU) implemented a household-based injury surveillance tool that detected injuries that took places within four months of each of the three interviews. This cross-sectional study followed up on individuals who reported an injury during three rounds of injury surveillance data collection and conducted in-depth interviews about the individual's most recent injury.

Among the 643 injured individuals living in the rural IM-DSS, males constituted 63% of the sample, nearly half had between five and 29 years of age, and 53% fell in the highest or second highest wealth quintile. When traveling to first time injury care, most reached the site within an hour and an average of 0.5 USD was spent on transportation. Those who chose to travel by foot or bicycle spent a relatively shorter time traveling to care. Cost of the initial care amounted to an average of seven dollars, and in contrast to receiving care from a traditional healer, choosing to seek care from a private clinic or from a public hospital led to a significantly greater cost of care. Individuals who went to traditional healers spent significantly longer periods of time in functional limitation compared to those who went to private clinics and even drug stores or pharmacies.

Among the employed, 10% were unable to return to his or her occupation following the injury, and among those who did return to their jobs, the average number of missed work days was 31. Length of time spent in functional impairment due to the injury was strongly and positively associated with cost of transportation, cost of care, job loss, number of work days lost, and number of school days lost. None of the seven socioeconomic consequences had a significant relationship with household wealth, but this finding does not exclude the possibility that injuries impose a regressive relative cost burden on patients. Finally, three demographic characteristics seemed to exacerbate the direct negative consequences of injury: those who were 45 years of age or older spent longer period of time travelling to initial care, males spent more money on initial injury care, and injured children from female-led households experienced less missed school days than did children from male-led households. These findings inform our understanding of the direct socioeconomic burden of injury in rural Uganda, draw attention to vulnerable population sub-groups, and support advocacy for a major injury control effort that would greatly improve population health as well as yield potential economic benefits.

Introduction

In 2013, intentional and unintentional injuries had led to the deaths of over 4.8 million people, accounting for nearly ten percent of global mortality.[1] Injuries contributed to 276 million disability-adjusted life years (DALYs), which was 11% of all DALYs lost around the world. A large injury burden lies in sub-Saharan Africa, where injuries contributed to over 7% of all DALYs lost in the region.[2] Between 1980 and 2010, road traffic injury (RTI) death rates increased by 29.8% in the southern region.[3] In western sub-Saharan Africa, this increase was 15.2%, and motorized road transport was the third leading cause of death and one of the top five risk factors for loss of DALYs in 2010.

In addition to the loss of mortality and morbidity due to injuries, existing literature indicates that the injured faces a number of direct socioeconomic consequences. For example, more than a quarter of all Vietnamese households with a member who received in-patient hospital-based care for his or her injury spent more than 40% of its capacity to pay for medical treatment,[4] a threshold that has been used to define a "catastrophic expenditure."[5] A population-based survey conducted in Nigeria found that among those who experienced an RTI, six out of 36 employed individuals lost their jobs and more than a third lost between one and four weeks of work.[6]

But evidence on the direct socioeconomic consequences experienced by individuals afflicted by an injury of any cause in sub-Saharan countries such as Uganda has been limited to date. Such research would strengthen the argument for injury prevention and treatment by demonstrating that they can keep millions around the world not only safe from injuries but also free to achieve their social and economic well-being.

Conceptual framework

A conceptual framework was constructed to guide the design and analysis of this study, and it is based on three existing frameworks. First, to explain the patterning of disease and death, Link and Phelan developed the fundamental cause theory to highlight the dynamic process through which social conditions such as sex, ethnicity education, and income affect health. When effective interventions or preventative measures become available to a population, those who have greater access to wealth, power, prestige, and beneficial social networks confer the health advantage to protect or treat themselves. This framework thus compels one to examine how social conditions shape risk factors for illness and death. World Health Organization's Commission on Social Determinants of Health developed a similar framework to explain health equity, and this framework categorized risk factors into biological factors, behaviors, material conditions, and psychosocial factors.[7]

While the determinants of health are strongly sociological in nature, the distribution of health and well-being, in turn, influences social hierarchy. This process is captured by the second framework of interest to this study: the Financial and Economic Impacts of Disease or Injury on Households (Figure 1) by the *World Health Organization (WHO) Guide To Identifying the Economic Consequences of Disease and Injury*.[8] An ill health event can impede a household's ability to achieve the three utility objectives of maximizing leisure time, consumption of home-produced goods, and consumption of non-health market goods. The household may suffer losses in paid or unpaid production, increase of consumption of services and goods related to care required for the ill health event, and decrease of consumption of non-health goods and services such as food and clothing.

A third framework similarly explores the aftermath of an illness including its costs and financial impacts (Figure 2).[9] The first three boxes of Russell's framework resembles the information presented in the framework described above (Figure 1), in that an illness leads to a number of direct and indirect costs which again include expenditures related to seeking treatment or loss of productive labor time.

Drawing from these three frameworks, this study will follow a framework describing the socioeconomic disparities of injury and the individual's socioeconomic consequences (Figure 3). Socioeconomic status can effect injury risk factors such as choosing not to wear a motorcycle helmet, having frail bone structure, working in an area that has poorly constructed roads, and feeling psychological stress on the day of the injury. The availability of quality health care also shapes incidence and outcome of an injury. Finally, an incident injury will lead to a combination of morbidity, disability, and/or death, an outcome that will depend on the individual's interaction with the health care system. The household with an injured member may suffer the various market and non-market related economic consequences, including a decline in paid and unpaid production, a decrease consumption of non-health goods and services and assets, and increases in health goods and services. All of these events ultimately contribute to an injury's socioeconomic impact on a household, which, in turn, feeds back into household socioeconomic status.

Goals and Objectives

The overall goal of this study is describe the direct socioeconomic outcomes occurring as a result of an injury in the rural Iganga and Mayuge Demographic Surveillance Site (IM-DSS)).

The specific objectives of this study are: (1) to measure time and cost of initial care, (2) to measure loss of employment, lost work time, and missed school time, and (3) to determine how sociodemographic and injury characteristics predict the consequences in the previous objectives

Methods

Study design and data sources

This follow-up cross-sectional study utilizes data from a demographic surveillance system, which is a population-based site that tracks demographic events and monitors health in a geographically defined population over time.[10] The Iganga-Mayuge Demographic Surveillance Site (IM-DSS) was established in partnership with Makerere University in 2005 with the goal of generating information to support evidence-based decisions and policy making in the Iganga and Mayuge districts but also at a national level. The site is based in a predominantly rural region in eastern Uganda, about 120 km east of the capital Kampala (Figure 4).

In 2008, the Johns Hopkins University International Injury Research Unit (JH-IIRU) collaborated with the IM-DSS to explore innovative approaches to screen for disability and to characterize it through an in-depth disability and injury assessment module that was designed to be incorporated into regular IM-DSS data collection (Appendix 1).[11,12] The injury component of this survey asked the head of each household (or the senior most member of the household present at the time of the interview) if any member of the household had an injury in the last four months. Injuries were defined as that which prevented "the victim from carrying out his or her normal daily activities for at least one day or for which [the household] paid for any treatment." The four-month period was chosen because the IM-DSS collects data once every four months. The first data collection took place during February—April 2009, the second round took place during March—May 2010, and the third took place in January—February 2011.

The 1,059 individuals who reported an injury according to the parent survey described above form the target population for this study. Enrollment of subjects began in August 2011, taking place outside of the regular IM-DSS rounds of data collection, and continued through October 2011. Field assistants followed up each subject through a visit to his or her household, requested study participation, and obtained consent before proceeding with the survey. In cases where the subject was not present in the household during hours of data collection or was under the age of 18 years, the head of the household provided responses on his or her behalf.

Household-based interviews began with the question of when was the subject's most recent injury. The field assistants explained injury was defined as something which prevents someone from carrying out normal daily activities for at least one day or something for which someone paid for any treatment, and then provided examples such as RTIs, violence-related injuries, poisoning, burns, animal bites, and unintentional falls. Then a structured survey collected information on that injury event. Information included the type of injury, risk factors and events leading to the injury, health care that was sought and received following the injury, and socioeconomic consequences of the injury (Appendix 2). Outcomes in the survey included changes in income, food production, and food purchases due to the injury, and various methods of coping with the injury financially. The survey questions were adapted from the World Health Organization (WHO) Guidelines for Conducting Community Surveys on Injuries and Violence and from the World Bank's Living Standards Measurement Study.[13,14] The survey instrument was translated into Lusoga using a standard translation-back-translation protocol,[15] and the translated instrument was pre-tested with local field workers to ensure accuracy of the translation process as well as the clarity of the questions. Interviews were conducted in the local language of Lusoga and all field assistants come from the Iganga and Mayuge communities.

In addition to the data collected from the survey, this study utilizes three datasets from IM-DSS. All survey instruments were consistent with other demographic surveillance sites which are part of the international INDEPTH network.[16] First, the IM-DSS field team collects health and demographic data from all individuals in all households in the site every four months. The demographic information includes migrations, births, age, sex, deaths, and verbal autopsy (Table 1).

Second, the site has collected household socioeconomic information during October 2008—March 2009. These data include occupation of the household head, physical characteristics of the household such as the materials used for the roof and main source of water, and ownership of various household assets.

Third, this study uses a database developed by the IM-DSS to classify each of the 65 villages in the area as either rural or peri-urban based. All villages that formed the Iganga Town Council were considered peri-urban while the majority of villages fell into the rural category with some exceptions.

Sample

The study sample was determined by the distribution of two independent variables of interest. First, the injured individual's household wealth is measured through an asset index (further explained in the next section). Constructing an asset index for combined rural and urban regions can misclassify a household's quintile, particularly in situations where one asset may indicate greater wealth in one location but lesser wealth in another.[17,18] A stratified analysis that differentiates the sample by the village development, rural or peri-urban, would be the best approach to studying socioeconomic consequences and controlling for characteristics such as household wealth. But the peri-urban sample is too small to model for nominal or even dichotomous outcomes, so this study focuses specifically on the rural region of the IM-DSS. Second, a largely uneven distribution was observed for the variable on whether or not the individual sought care after the scene of the injury (further explained in the results section). In the interest of building models that include independent variables capturing the loss of money and time when seeking initial time care, this study included only those individuals who sought care after the injury.

Outcome variables

This study's major outcomes of interest are (1) hours spent traveling to initial care among those who decided to travel to seek care, (2) cost of transportation to initial care, (3) cost of initial care, (4) ability to return to one's occupation among those who were employed at the time of the injury, (5) number of work days lost among those who were able to return to the occupation held at the time of the injury, and (7) number of school days missed among those who were students at the time of the injury.

Independent variables

The independent variables include sociodemographic characteristic, including sex, age, household head occupation, and household wealth, and injury characteristics, including cause of injury, duration of time during which the injured was unable to resume usual activities, and the total costs associated with seeking and receiving first time care (Table 2).

To construct a wealth quintile variable and handle the high-dimensional nature of the asset data from 7,355 rural households in IM-DSS, a principal components analysis (PCA) was conducted.[19] In this analysis, each asset is a random vector of dimension *p* with a finite *p* x *p* variance-covariance matrix. Two kinds of variables were included in the PCA (Table 3): dichotomous variables, representing household ownership or non-ownership and taking on the values of either zero or one; and discrete and ordinal variables, such as main source of light. To handle the discrete and ordinal nature of information, covariances between variables were estimated using a polychoric correlation.[20] The PCA then identifies patterns in the information on assets, highlights similarities and differences, and reduces the high-dimensional data to orthogonal linear combinations of variables, a simpler dimension that captures the underlying construct. The linear combination of asset scores with the greatest amount of information common to all of the variables, represented by the largest variance of the projections of the vectors, is known as the first principal component. The percentage of variance in the asset items demonstrates the extent to which the variation in asset items between households can be explained by this one measure of SES.

The strength of the association of an item with this first principal component determines the weight of the items in the asset index, or the factor score. An important assumption for the model is that this first principal component represents the construct of household wealth.[19] The asset index score (A_j) for each household j is calculated as follows:

$$A_j = f_1 \times (a_{j1} - a_1) / (s_1) + \dots + f_N \times (a_{jN} - a_N) / (s_N)$$

where
f_1 = the "scoring factor" for the first asset as determined by the analysis
a_{j1} = the jth household's value for the first asset
a_1 = the mean of the first asset variable over all households
s_1 = the standard deviation of the first asset variable over all households

Then, looking at the frequency distribution of the asset index scores of the households, a distribution that is weighted in the same way that the items in the asset index are weighted, this study will rank households by their individual scores and create cutpoints to divide the distribution into quintiles, or five sections constituting 20% of the sample.

The selection of assets for the PCA began with gathering expert opinions from the Uganda-based investigators, as their local knowledge helped identify which variables do not perform well in differentiating the wealth of one household from that of another.[21] First, given the greater availability of land to a rural household, burning waste and disposing waste, particularly biodegradable waste, in the gardens is practiced by both affluent and less affluent homes. Second, the main source of drinking water and type of toilet used by the household often depends on the infrastructure available on a community level, so this variable was omitted in the interest of separating community from household wealth effects. Third, the dichotomous variable on land ownership was also described as being ambiguous, as it does not capture the quality of land. Similarly, information on household's type of dwelling tenure does not accurately portray the household's wealth. The majority of the 7,355 households constructed and own their dwellings (74%) while 12% rent from an individual. But attaching a monetary value to this type of asset ownership is complicated due to a weak housing sale and rental market and because construction of these houses often uses found materials and/or minimal material resources.[22,23] Data on the quality of the dwelling's materials such as those used for the roof, wall, and floor, are included in this analysis, but type of tenure is not. Finally, data from a 2005 IM-DSS round reveal that out of 60,228 participants, 55% were Muslim, so owning a pig was omitted from the asset analysis.

Descriptive analyses also identified assets that should be excluded due to a large proportion of missing data. All of the variables on the quantity of a specific food, such as rice, maize, or millet, stored by the household at the time of the interview had missing data for more than three quarters of the rural households. Information on availability of shutters and on whether or not the household land or plot was enough to grow food to feed its members had missing data for more than 20% of the household sample, so this variable was removed from the analysis as well.

The estimation of covariances between the asset variables through a polychoric correlation brought attention to variables that cause missing correlation: ownership of a car, gas or electric cooker, a car, a truck, bus, or tractor, a landline phone or a bed. These binary variables have a very small group of ones or zeros, a quality that does not conform well to the polychoric assumption that two latent bivariate normally distributed random variables generate two observed ordinal scores.[20,24]

Using the final set of assets (Table 4), a raw total asset score was calculated for each of the 7,355 households. The 0.29 skew of this score variable and the appearance of the histogram in comparison to a normal distribution curve indicate a slightly positive skewness (Figure 5). The PCA reduces the dimensions of these asset data so that the first principal component represents household wealth. The proportion of variance explained by this first principal component can affect the index's risk of misclassifying a household in the wrong group, so this study aimed to build an index where the first component explained at least 30% of the variance. In this study, the first principal component based on the final set of asset variables accounted for 32% of the variance (Figure 6).

Two additional indices were created with the purpose of comparing different weighting methods and their impact on household classification results. First, selecting from the same set of variables used for polychoric PCA-based index, this study conducted the PCA method that was originally developed for the multivariate normal distribution using the Pearson's correlation matrix.[25] The resulting index, however, presented problems that warranted attention. Due to numerous weak coefficients displayed in the correlation matrix, extensive variable pruning was required to yield an index with a first component explaining 28.6% of the data (Figure 7). This final set excluded more than two-thirds of the total number of assets including in the polychoric PCA-based asset index, a very noticeable loss of rural household asset information (Table 4). Furthermore, the slightly positively skewed score distribution (Figure 8) appears uneven and reveals that large proportion of households have the same score. This clumping quality can impede one's ability to create even wealth quintiles and properly differentiate between households by wealth.[26] Due to these potential threats to being able to distinguish between the relative poorer and richer households, the Pearson correlation-based PCA asset index was not included in this analysis.

A second alternative approach to constructing an asset index is the simple sum of assets, and previous studies have used this straightforward method that computes a sum across binary asset variables and equal weight to asset regardless of its quality.[27-29] This index included all of the variables used for the polychoric PCA-based asset index (Table 4), but six categorical variables were recoded into binary ones. Expert opinions from the Uganda-based investigators were solicited to ensure that the dichotomy of theses variables was appropriate and meaningful (Table 5). The resulting sum of assets index score had a very low value of positive skewness (0.09) and a fairly even normal distribution.

Finally, the 7,355 households were classified into quintiles based on their asset index score built through polychoric PCA method as well the simple sum of assets method for the sake of comparison. For example, the first quintile consists of the poorest individuals whose score values comprise the lowest 20% of the index.

Missing data

A general consensus on what is considered a passable amount of missing data does not currently exist. In a review of education and psychology studies, the maximum proportion of missing cases was over 27%.[30] This study made the decision that a variable with data missing among over 20% of the households would pose a threat to statistical conclusions and generalizability. For a variable missing less than 20% of the sample's data, in response to the potential threat to making valid references, this study implemented multiple imputation, which has been shown to generate unbiased parameter estimates reflecting the uncertainty associated with estimating missing data and to perform adequately even in datasets with large amounts of missingness.[31-33] This method creates regression models for each variable to calculate and fills in missing information, and multiple rounds of this procedure results in a combined imputed data set that can be used for one overall analysis. This study employed the chained equation approach to multiple imputation, which assumes that missing data are missing at random and runs a series of regression models so that each variable with missing data is modeled according to its type of distribution (e.g. logistic or multinomial) conditional upon the other variables in the data.[34]

Analysis

<u>Frequency distributions</u>

To explore the financial coping mechanisms and characteristics of help received due to difficulty with the injury, descriptive analyses and frequency distributions were conducted.

Regression models

Multivariable regression models were built to examine the effects of the sociodemographic- and injury-related independent variables of interest on the six study outcomes (Table 5).

The first outcome, hours spent traveling to initial care among those who decided to travel to seek care, has a categorical and ordinal nature, so the appropriate model is the ordered logit model.[35] The outcome of hours spent traveling to care can be understood as a latent variable Y_i* where the observed outcome variable *y* that determines the category Y_i. Cutpoints *q* determine that Y_i takes on a value of 1 if Y_i* is below q_1, a value of 2 if if Y_i* is between q_1 and q_2, a value of 3 if Y_i* is between q_2 and q_3, and so forth. In the population, the model of continuous latent variable Y* follows a linear form is defined as follows:

$Y_i^* = \beta^* \mathbf{x}_i + \varepsilon_i$
where
$\mathbf{x}_i$ is a row vector with a 1 in the first column for the intercept
β^* is a vector of structural coefficients with the first element being the intercept β_0
ε_i is a random disturbance term with a logistic distribution and a cumulative distribution function $F(e_i)$

Second, consider then that the probability of the response of the i^{th} individual falling in the j^{th} category or below, g_{ij}, given $\mathbf{x}_{i}$,, is denoted below:

g_{ij}
$= \Pr(Y_i^* < q_j)$
$= \Pr(\varepsilon_i < q_j - \beta^* x_i)$
$= F(q_j - \beta^* x_i)$

The probability that an individual with characteristics x_i will have an outcome that crosses multiple cutpoints q: (1) cutpoint q_0 separating no loss of days from a loss of one to seven days, (2) cutpoint q_1, separating a loss of one to seven days from a loss of eight to fourteen days, and so forth. The probability that an individual's response to the question on lost workdays falls into one of the resulting categories, the j^{th} category, is denoted as $\Pr(Y_i = j)$. The probability that the individual falls into that category, the j^{th} category, or below is then the cumulative probability, g_{ij}, which is denoted as $g_{ij} = \Pr(Y_{ij}$). This cumulative property of g_{ij} is illustrated below:

$g_{ij} = p_{i1} + p_{i2} + p_{ij}$

Mapping these probabilities to a line, let g(.) denote a link function to illustrate how the transformed cumulative probabilities are a linear function of the independent variables of interest, as shown below:

$g(g_{ij}) = q_j + x_i\beta$

where
q_j is a constant representing the baseline value of the transformed cumulative probability for category j
β is the effect of the covariates on the transformed cumulative probabilities

Directly extending the familiar logistic regression model, the model applies the logit transformation to the cumulative response probabilities g_{ij} so that

$\text{logit}(g_{ij})$
$= \log [g_{ij}/(1- g_{ij})]$
$= q_j + x_i\beta$

where
$\mathbf{x}_i$ is a row vector of predictors with a 1 in the first column for the intercept (because the constant is absorbed in the cutpoints)
$\boldsymbol{\beta}$ is a vector of structural coefficients with the first element being the intercept β_0 and the model assumes that the random disturbance term ε_i has a logistic distribution q
q_j is the cutpoint absorbing the constant

After exponentiating both sides, we can calculate the odds of a response in category j or below as follows:

$g_{ij}/(1- g_{ij})$
$= \exp(q_j) \exp(x_i\beta)$

where $\exp(q_j)$ can be interpreted as the baseline odds of a response in category j or below when $x = 0$.

The covariates have the effect of increasing or decreasing the odds of having a response in category j or below by a factor of $\exp(x_i\beta)$.

A number of outcomes are based on count data: cost of transportation to initial care, cost of initial care services , number of work days lost among those who were able to return to the occupation held at the time of the injury, and number of school days missed among those who were students at the time of the injury. All of the data for these outcomes demonstrate an over-dispersion, so this analysis built a negative binomial regression model.[36] This model starts with a Poisson regression model[37] where the Poisson probability distribution is

$\Pr(Y=y|\ \lambda) = (e^{-\lambda} * \lambda^{\lambda}) / y!$ for $y = 0, 1, 2$

where λ is the mean or expected valued of a poisson distribution as well as the variance of a poisson distribution

The maximum likelihood of a Poisson regression model is

$$L\left(\beta \mid \mathbf{y},\mathbf{X}\right)=\prod_{i=1}^{N}\Pr\left(y_i \mid \mu_i\right)=\prod_{i=1}^{N}\frac{\exp\left(-\mu_i\right)\mu_i^{y_i}}{y\,!}$$

where $\mu_i = E(y_i|x_i) = \exp(x_i\beta)$

Given that the data for these four outcomes demonstrate that the variance of the outcome exceeds the mean, a negative binomial regression model was built due to its feature of an additional parameter that allows for such a relationship between conditional variance and conditional mean. The formula for this distribution that can be used to model count data with overdispersion is as follows:

$$\Pr(Y=y|\lambda,\alpha)=\frac{\Gamma(y+\alpha^{-1})}{y!\Gamma(\alpha^{-1})}\left(\frac{\alpha^{-1}}{\alpha^{-1}+\lambda}\right)^{\alpha^{-1}}\left(\frac{\lambda}{\alpha^{-1}+\lambda}\right)^{y}$$

where λ is the mean or expected valued of the distribution
α is the over dispersion parameter, and when this is 0, the distribution is the same as the poisson distribution

The maximum likelihood formulation for negative binomial regression model estimation is

$$L(\beta \mid \mathbf{y},\mathbf{X})=\prod_{i=1}^{N}\Pr(y_i \mid \mathbf{x}_i)=\prod_{i=1}^{N}\frac{\Gamma(y+\alpha^{-1})}{y!\Gamma(\alpha^{-1})}\left(\frac{\alpha^{-1}}{\alpha^{-1}+\mu_i}\right)^{\alpha^{-1}}\left(\frac{\mu_i}{\alpha^{-1}+\mu_i}\right)^{y_i}$$

where $\mu_i = E(y_i|x_i) = \exp(x_i\beta)$

Finally, the outcome of whether or not employed individuals were able to return to their occupation has a binary nature, so this analysis built a logit model.[38] The observed outcome variable *y* was understood as capturing some information about a latent variable *y** that ranges from -∞ to +∞ and that is linearly related to the observed independent variables. This latent value represents an underlying propensity for the outcome and generates the observed *y*'s. Respondents who have larger values of *y** are observed as *y*=1 while those with smaller values are observed as *y*=0. The estimation equation is as follows:

$$\mathrm{Ln}\,[(\Pr(Y_{ij}=1)/(1-\Pr(Y_{ij}=1)]$$
$$=\mathrm{Ln}\,[(\Pr(Y_{ij}=1)/(\Pr(Y_{ij}=0)] = \beta_0 + \beta_1\,\mathrm{x} + \beta_2\mathrm{injury}$$

where
x_i is a vector of covariates
β_0 is the baseline value for observations with all covariates equal to zero

Maximum likelihood (ML) was used for model estimation under the assumption that the errors follow a logistic distribution. The coefficient values resulting from this estimation were transformed into the more interpretable odds ratio of the outcome.

Results

A total of 1,059 individuals were in the target population because they reported experiencing an injury according to the JHU-IIRU injury assessment module (Figure 9). During follow-up, it was found that 145 had moved to another household outside of the IM-DSS, 100 reported not experiencing the injury that was previously reported, 11 refused to participate, and nine were deceased. This study found that 41 individuals did not fit the criteria of experiencing an injury because they were able to resume usual activities within the first day, so this group was excluded from the study, leaving a total of 749 individuals. Of these individuals, only 85 (11%) live in peri-urban areas, and chi square tests comparing some sample characteristics reveal significant differences by sex, the injured's occupation, and the household head's occupation (Table 5). Among the 668 individuals living in the rural IM-DSS sample, the data again displays a largely uneven distribution where 643 individuals sought care after the scene of the injury, 25 did not do so, thus bringing the final sample to 643 individuals.

Males constituted a greater percentage of the sample (63%) than did females, and 49% were between the ages of 5 and 29 years (Table 7). Among those who were employed at the time of the injury, nearly one-fourth of the sample held an occupation in farming or agriculture, but a large percentage was not earning a formal income. Among those who were economically inactive, 37% were students (37%) and about nine percent were pre-school children, and this corresponds well with the observation that over half of the sample relates to the household head as his or her child or grandchild. Farming or agriculture was the dominant professions among the injured's household heads (45%) while 15% of study subjects came from households led by a laborer, and 82% of the injured's households were led by a male. More than 53% of the injured lived in households that fell in the highest or second highest PCA-based wealth quintiles, while only 12.4% fell in the lowest. When wealth was measured as a simple sum of assets, 48% fell in the top two quintiles while over 15% belonged to households in the poorest group.

Leading causes of injuries were RTIs (44%), unintentional falls (28%) and burns (10%) (Table 8). The amount of time between the interview and the subject's most recent injury varied, as 40% experienced the injury within 12 months of the date of the interview while 51% reported that the injury occurred 18 to 36 months prior to the interview. The most common modes of transportation to the site were by motorcycle (40%) and by bicycle (34%) and the most common sources of initial injury care were hospital (35%) and private clinics (35%).

Direct socioeconomic outcomes

Among the 623 individuals who traveled to seek care after the scene of the injury, the majority of study subjects (64%) reported that they had traveled for less than an hour to the site of care while one quarter of the sample traveled for a duration of one to three hours (Table 9). Excluding the 75 individuals who travelled by foot and 20 individuals who sought care from either a pharmacy or drug store or sought *kugemamu*, a type of massage, average amount of money spent on transportation to first time care was 0.40 USD (95% CI 0.32, 0.48). In the sample of 643 individuals, 601 reported on the cost of first time care, and the average was 6.9 USD (95% CI 5.61, 8.17).

Nearly 90% of the 334 employed individuals were able to return to his or her occupation following the injury, but the average number of work days lost due to the injury was 31 days (95% CI 25.6, 36.2) with a standard deviation of 46 days. When categorized into three time periods of one to six days, one to four weeks, and over four weeks, the distribution of work days lost was 22%, 53%, and 25%, respectively. The average number of school days lost among the 288 students was 21 days (95% CI 15.9, 25.3) with a standard deviation of 36 days (this estimate includes 14 students (6%) who did not miss any school days following the injury). Among the 632 subjects who had restored functionality within the recall period, over half needed one to four weeks to resume usual activities while 24% experienced functional limitation for more than one month.

<u>Time spent traveling to first time care</u>

Univariate models found that the proportional odds ratios for an increase in time spent traveling to first time care were significant by a number of factors including being over 60 years of age, traveling by foot, and seeking care from a private clinic, a hospital, or the "other category" which primarily includes drug stores or pharmacies (Table 9). In the multivariable model controlling for all other variables, individuals in the 45 to 60 and over 60 years of age groups experienced a significantly greater amount of time spent traveling than did those under the age of 15 years (OR, 2.2, 95% CI, 1.02, 4.58; OR, 3.3, 95% CI, 1.37, 7.75). In contrast to those who were not earning an income at the time of the injury, bodaboda drivers had significantly lower odds for increased transport time. Specifically, compared to those not employed, the odds of bodaboda drivers traveling for more than three hours versus three or less hours was 0.41 times lower; likewise, the odds of traveling more than one hour versus less than one hour was also 0.41 times lower (95% CI, 0.18, 0.94), given the other variables are held constant in the model. Similarly, having an RTI rather than an unintentional fall reduced the odds of longer transport time by 48% (95% CI, 0.18, 0.94). Those who traveled to first time care by foot, in contrast to those who traveled by motorcycle, had significantly lower odds of spending greater lengths of time in transport (OR, 0.29, 95% CI, 0.14, 0.6). Seeking care from a hospital rather than a traditional practitioner increased the odds of reporting that the transportation took more than three hours, relative to less than three hours, by 3.3-fold (95% CI, 1.43, 7.57), and this association also applies to reporting more than one hour relative to less than one hour. The relationship between time spent in transport and injury severity was also significant, as those whose injuries resulted in functional limitation for over a month were less likely to report greater lengths of time traveling to first time care (OR, 0.52, 95% CI, 0.33, 0.81).

Money spent traveling to first time care

The results of simple negative binomial regression models found that some characteristics significantly increased the expected amount of money spent on transportation to first time care: experiencing the injury within six to twelve months, rather than less than six months, of the interview, using a four wheel motorized vehicle to travel to first time care, traveling to a hospital, and having an injury that left the individual unable to resume usual activities for more than one month (Table 10). Traveling to first time care by bicycle, however, significantly decreased the cost of transport. When adjusting for all covariates in the model, having an RTI rather than an unintentional fall decreased the predicted amount of money spent on transportation by 42% (IRR, 0.58, 95% CI, 0.35, 0.96). The incidence rate ratio for experiencing the injury within six to twelve months of the interview, compared to less than six months, was significant and with a magnitude of 1.8 (95% CI, 1.16, 2.92). Using a bicycle to get to care significantly decreased the predicted money spent by a factor of 0.11 (95% CI, 0.06, 0.19) while traveling in a four wheel motorized vehicle increased money spent by a factor of 2.06 (95% CI, 1.46, 2.9). Finally, compared to injuries that resulted in functional limitation for a period of one to six days, the most severe injuries statistically increased the expected amount of USD spent by a factor of 1.69 (95% CI, 1.11, 2.56).

Money spent on first time injury care

Among the rural sub-sample, the unadjusted incidence rate ratios for money spent on first time care were significant and greater than one among injured individuals who had between 15 and 45 years of age or over 60 years of age, had an RTI or an injury with a cause in the "other" category (which mostly consists of burns, intentional injuries, and stab or cuts) sought care from a hospital or a private clinics rather than a traditional practitioner, or had an injury resulting in functional limitation over a period lasting more than one week (Table 11). In the multivariable model adjusting for all covariates, being male emerged as a significant factor in increasing the predicted USD spent on first time care (IRR, 1.24, 95% CI, 1.02, 1.52). Individuals who reported that their injuries took place within six to twelve months of the interview, compared to those who had injuries within six months, also had a significantly larger expected amount of money spent (IRR, 1.84, 95% CI, 1.16, 2.92). In contrast to seeking care from a traditional practitioner, the predicted amount of money significantly increased when individuals sought care from a private clinic (IRR, 2.02, 95% CI, 1.52, 2.77) or a hospital (IRR, 4.07, 95% CI, 3.09, 5.35). Having a functional limitation for one to four weeks, rather than less than one week, increased the expected money spent by a factor of 1.9 (95% CI, 1.46, 2.54), while having such a limitation for more than one month increased the expected outcome by a factor of 4.57 (95% CI, 3.16, 6.61).

Returning to one's occupation following the injury

According to the univariate logistic regression models for not being able to return to one's occupation following the injury, the oldest age group, compared to those under 30 years of age, was more significantly likely to experience this negative injury consequence, as compared to those working as professionals, in shops or business, or as bodaboda drivers (Table 12). Having a functional limitation that endured for more than one month, compared to a limitation that lasted for less than a month, also increased the odds of an individual not being able to return to his or her occupation (OR, 8.48, 95% CI, 4.04, 17.8). When controlling for all variables, this relationship with injury severity increased in magnitude and it was the only one remaining significant (OR, 10.6 95% CI, 4.99, 22.65).

Number of work days lost following the injury

The results of simple negative binomial regression models found that among those who were able to return to their occupation following the injury, the expected number of work days lost was significantly higher among those over the age of 45 years than among those under 30 years and those who were unable to resume usual activities for longer than a month (Table 13). Belonging to the second poorest group rather than the highest group decreased the odds of the outcome. When adjusting for all covariates in the model, the predicted number of work days lost was only affected by the individual's functional limitation lasting for more than one month (OR, 3.96 95% CI, 2.89, 5.43).

Number of school days lost following the injury

Negative binomial estimation of school days lost among students also reveals the importance of functional limitation (Table 14). The variable for not being able to resume usual activities for over a month had a significant association with school days lost in both the simple (OR, 7.1 95% CI, 5.22, 9.76) and multiple regression models (OR, 6.1 95% CI, 4.19, 8.96). The only other factor that had a statistically significant adjusted incidence rate ratio was the sex of the household head. Coming from a home led by a female rather than a male decreased the expected number of school days lost by 38% (IRR, 0.62, 95% CI, 0.4, 0.95).

Associations with wealth measured with the simple sum of assets approach

The associations between each of the seven socioeconomic outcomes and household wealth, as constructed through a polychoric PCA asset index and then estimated by the multiple regression models described above, do not appear very different from those from the counterpart models where wealth was constructed through the simple sum of asset approach (Table 15). One notable exception is that among those who were able to return to their occupations following the injury, compared to being in richest quintile, belonging to the poorest one significantly increased the predicted number of work days lost by a factor of two (95% CI, 1.22, 3.85). This incidence rate ratio differs from the insignificant one estimated by the model with the wealth variable created by a polychoric PCA (IRR, 1.54 95% CI, 0.82, 2.91). But the significance tests for all of the other wealth associations measured in this study reached the same conclusions regardless of the asset index weighting method, and when comparing the magnitude of the associations between the two approaches, 60% remained within 0.1 percentage points of one another.

Discussion

This follow-up cross-sectional study describes and estimates a host of negative direct socioeconomic effects of injury at the individual level among those who sought care after the scene of the injury. When traveling to the site of care, the most common experience was losing less than an hour's worth of time, and study subjects spent an average of 0.5 USD. The cost of the initial care amounted to an average of seven dollars, and this figure can be compared to Juilliard's estimate that the total cost of RTI treatment within a 12-month period in Nigeria was $25.4 USD (Table 16).[6] Among the employed, only 10% were unable to return to his or her occupation following the injury, and this figure is very close to the percentage of people who lost their jobs due to an RTI in the Nigerian study. Among the majority who were able to return to their jobs, the average number of missed work days was 31, over half of the injured lost between one and four weeks of work, and one quarter missed over a month of work. This distribution demonstrated more severe productivity losses than those found in Nigeria and in Ghana, where the average time lost that an injured person lost from his or her usual activities was 22 days.[39] The vast majority of students struggled with returning to school following an injury, and the average number of school days lost was 21 days. All of these findings indicate a loss of time, money, productivity, and educational investment and broaden one's understanding of the socioeconomic toll of injuries. The importance of these consequences has been emphasized by previous studies measuring the economic costs of other diseases in low-income countries,[9,40,41] and this study adds to the evidence, spotlighting injures in a rural sub-Saharan African context.

Factors associated with direct socioeconomic consequences of injury

This study identified factors associated with the direct socioeconomic consequences of injury in rural Uganda. It should not be surprising that cost of transportation, cost of care, job loss, number of work days lost, and number of school days lost had a strongly significant positive association with the length of time spent in functional impairment due to the injury. The more striking finding is that none of the seven socioeconomic consequences explored in this study had a significant relationship with household wealth as measured through a polychoric PCA asset index. This conclusion holds true when the household wealth index was constructed through a simple sum of assets approach (with the exception of a significant two-fold increase in work days lost among the poorest wealth quintile compared to the richest). A literature review of studies on the economic costs of malaria, tuberculosis, and HIV/AIDS in LMICs[9] found that in nine countries, including two in sub-Saharan Africa,[42,43] poor families bore a cost burden greater than their wealthier counterparts. This discrepancy is explained by one key methodological difference: the reviewed studies had income data and thus captured the relative the costs of illness (relative to household income). In urban Malawi, for example, the absolute costs of care were three times greater among the non-poor than the poor, but relative to monthly income, the non-poor spent 129% and the poor spent 244%.[42] Thus, this study reveals that the magnitude or likelihood of negative socioeconomic consequences does not differ significantly by wealth ranking, but this finding does not exclude the possibility that injuries impose a regressive relative cost burden on patients.

The socioeconomic consequences that unfolded from study subject's choice on where to receive initial care and how to travel to care are particularly interesting. First, compared to traveling by motorcycle, traveling by a four-wheel motor vehicle significantly increased the amount of patient time and cost, while traveling by foot or bicycle significantly decreased these measures, indicating that those who traveled by the slowest modes of transportation were not traveling a very far distance. Second, choosing to seek care from a private clinic rather than a traditional healer led to significantly greater cost of care. This finding on the high cost of the private sector is unsurprising. In 2011 in Uganda, the percentage of total health expenditure that came from out-of-pocket health expenditure was 37% in 2009, but out-of-pocket health expenditure constituted 68% of total private health expenditure on health.[44]

Despite the government's abolition of user fees in public health units in 2001, seeking injury care from a public hospital increased the expected cost of care at an even greater magnitude than did private sector clinics. This finding affirms concerns expressed around informal fees and high out-of-pocket expenditures that still exist in the public sector.[45,46] Third, individuals who chose to seek initial care from traditional healers had significantly longer periods of time spent in functional limitation compared to those who went to private clinics and even drug stores or pharmacies. More research is needed to explore this finding as it raises the question of whether or not traditional healers provided injury care that was of lower quality than that provided by more formal sources. Alternatively, one could posit that those with the most severe injuries had a preference for traditional healers. In rural Nigeria, traditional treatment was the second most common form of care sought,[6] and in three rural districts of Uganda including Iganga, a major factor that influenced consumer choice of provider was proximity and low cost, and that study indeed found that traditional healers charged significantly lower prices for services.[47]

This study highlights three demographic characteristics that seemed to exacerbate direct negative consequences of injury. First, having 45 years of age or older significantly lengthened the time spent travelling to initial care. These two groups were also at greater risk for experiencing a functional limitation lasting for more than one month of time. Research in rural African settings has highlighted the challenge of improving the health of middle-aged people and those aged 60 years and older and of responding to the depreciation in daily functioning,[48-50] and this study draws attention to the vulnerability of older adults in terms of care seeking and frailty following an injury. Second, being male significantly increased the amount of money spent on initial injury care, and one must question why the reported costs were lower for injured women. For example, among HIV-positive women in western rural Uganda, a major barrier to obtaining and adhering to antiretroviral treatment from a program based in a regional hospital was the cost of transportation, and the qualitative interviews captured the frustration of being economically dependent on one's husband.[51] Third, having a female household head decreased the number of school days lost among students who experienced an injury, and this association is consistent with a study that found that in seven sub-Saharan African countries, compared to children living in households led by a male, children living in female-headed households had higher school enrollment rates and were more likely to complete the first four primary grades.[52] Lloyd and Blanc consider the explanation that female heads with child-rearing responsibilities are more childoriented in their financial decision-making and more likely to allocate resources to the children in their household, as opposed to male heads who may have other child support obligations outside of the household. Such a theory could help explain the education finding in this study.

Limitations and strengths

The findings from this study are subject to limitations in measurement and study design. First, for all outcomes in this study, measurement relies on the respondents' self-report and accuracy of recall. In one study in Ghana, it has been argued that to recall information on more severe injuries, the appropriate time period is 12 months.[53] In our study, differences in money spent on transportation and initial care were significantly higher among those whose injuries occurred within six to 12 months of the interview compared to those whose injuries occurred within six months. Further research is needed to identify determinants of memory decay and appropriate time periods for recall on injuries in sub-Saharan Africa. Similarly, the self-reported measures of travel cost and time are subject to error and are found to be inferior to objective GPS-based measures of distance.[54]

Second, while the study subjects attributed the consequences to the injury during their interviews, given the retrospective nature of the interview and the absence of a control group, the ability to describe this relationship between injuries and direct socioeconomic consequences as "causal" is limited.

Despite these concerns about self-reported measures, one study design feature provides an important benefit to the validity of these findings: the follow-up survey. The definition of an injury may be vague or difficult for a field assistant to explain to a respondent, but all study participants had previously reported an injury through a surveillance tool and were able to validate their injury status through their interviews.

Third, a measurement error is attributed to the development of the survey instrument and the understanding of work and labor. This study's measurement of productivity excluded those who were children (who are known to make an important contribution to household income and house chores[41]) and those who were not economically active but who were engaged in housework and caring for patients or children. This approach to defining productivity would lead to some underestimation of number of work days lost following an injury.

Fourth, the independent variable for household wealth may be limited by the fact that it is constructed through the asset index, as ownership of an asset does not always capture the quality of the asset.[19] Still, the measure of assets has been shown to have the advantage of being more reflective of long-run household wealth and to have a high predictive value in estimating the relationship between SES and outcomes such as educational enrollments and malaria prevalence.[19,55] Another important household characteristic that is related to wealth is household education, but due to a large proportion of missing data, this variable was not included in the analysis.

Selection bias is an issue of concern, as two groups of injured individuals are not represented in this study. Study criteria did not intentionally exclude those who died as a result of an injury, but this follow-up sample does represent any fatal injuries. By not studying individuals who lost their lives to injury, individuals who may have spent a significantly greater amount of time and money on care, the results are vulnerable to a survivor bias.

Furthermore, individuals who did not seek care after the scene of the injury were omitted from the analysis because they constituted a very small percentage of the sample. The decision not to seek care could be related to experiencing a minor injury, but this decision can also be related to not being able to pay for care and to suffering longer periods of functional limitation, and this study was unable to explore outcomes among this particular group of people.

Finally, this study is restricted to two eastern districts of Uganda, so findings on household consequences and coping methods may not be generalizable to other areas of the country. However, given the dearth of information on injuries and socioeconomic consequences in rural areas of Uganda and other sub-Saharan African countries, the focus on a rural population is valuable. This in-depth study also provides a more comprehensive picture of the socioeconomic effects of injuries by examining injuries of all causes, a range of different household consequences, and coping strategies.

Implications

This study yields new information for the purpose of aiding in the development of public health policies, programs, and interventions to meet the needs of individuals at risk of injuries. Although policy makers have recognized the importance of addressing injuries in Uganda,[56] the need remains substantially unmet. These findings inform our understanding of the direct socioeconomic burden of injury in rural Uganda, draw attention to vulnerable population sub-groups, and support advocacy for a major injury control effort that would greatly improve population health as well as yield potential economic benefits.

In contrast to the minority of injured individuals who paid a significantly greater amount of money to travel a long distance to initial care using a four wheel motor vehicle, people who traveled by foot or bicycle did not have to lose very much time and they certainly did not spent very much money. However, those who were over 60 years of age again emerged as a special needs sub-group, as they were more at risk of spending great lengths of time traveling to care. In the context of injuries in need of urgent or emergency care, both of these findings, which may be related to the affordability factor of choice of transportation, is worrisome. This paper encourages policy makers to consider subsidizing travel costs to improve access to care and supports Hsia et al's argument to decrease injury morbidity and mortality in Uganda through the development of a formal pre-hospital emergency system.[57] In the absence of such a system, this paper calls for the scale up of a basic but effective pre-hospital trauma care program for lay first-responders.[57,58]

The positive and significant relationships between length of time spent in functional limitation and loss of productivity and school investment calls for more investment in and effective strategies for injury treatment and rehabilitation. One strategy of particular interest is community-based rehabilitation (CBR) because it operates within community development and is implemented through joint efforts of people with disabilities themselves, families, organizations, and relevant government and non-governmental staekholders.[59] A six-year project that aimed to provide medical rehabilitation to children with locomotor impairments in Uganda evaluated its successes and identified a number of components that would be necessary for appropriate recovery and rehabilitation. This study recommends that policy makers follow this "recipe for success" which includes CBR, physiotherapy, access to orthopedic surgery, rehabilitation centers or hostels, orthopedic appliance workshops, and a transportation system such as a dedicated vehicle for transporting patients to and from referral centers.[60] This study also identified older adults as a special group that is particularly vulnerable to functional limitation.

Private sector providers were significantly associated with the shortest amount of time spent with a functional limitation, but their services were costly, and yet private clinics were selected for initial injury care as frequently as the public hospital that is meant to be free of user fees. These findings pave way to two implications. First, as expressed in a USAID Health Systems 20/20 report that assessed the Uganda health system, the public and private sectors should identify ways to move beyond co-existence and instead combine efforts to increase access to and improve quality of health care.[45] Such efforts would be particularly beneficial in the face of stock-outs or an inability to deliver care due to insufficient staff or specialty care. The second implication is that high out-of-pocket expenditures in rural Uganda must take high priority in health and policy planning. Pro-poor financing mechanisms must be explored, implemented and evaluated, including micro insurance schemes targeting the poor[61] and vouchers.[62,63] Policy makers at the national level must also learn from the insurance reforms in countries such as Rwanda and Ghana and consider the adoption of a national health insurance scheme that is specifically pro-poor.[64-66]

Finally, this paper gives impetus for future research about direct socioeconomic consequences of injuries and the strategies to mitigate these effects. First, to build on this study, future work should collect information on all costs of care beyond the initial treatment, household consumption data and the household's capacity to pay for medical treatment so that relative costs of care can be calculated and the threshold for catastrophic expenditure can be explored.[67] Second, future work must take on the complex task of applying values to the productivity time loss, for aggregating total direct costs of injury serves the purpose of capturing the full scope of impact and allows for cost-effectiveness analyses of interventions. Third, to build on this study and explore the causal effect of an injury on loss of productivity, a longitudinal study with a group of non-injured persons presenting counterfactual levels of characteristics that may influence the likelihood of becoming injured would be preferable.

Fourth, since this study reveals which modes of transportation and which types of care were more expensive or required longer periods of time in transport, one must understand how such associations impact consumer preferences and care seeking behaviors. In Nigeria, 50% of injured individuals cited that cost of care or geographical proximity was the main factor driving the choice for type of first treatment,[6] and in rural Uganda, choice of provider for care of all types was commonly driven by perception of the provider's technical skills and proximity.[47] For the purpose of properly devising injury interventions in eastern rural Uganda, similar research can be conducted to assess attitudes, perceptions and preferences for type of injury care.

This study fills a gap in the existing literature on the socioeconomic consequences of injuries and can perhaps serve as a platform for a multi-country DSS-based investigation of the relationship between injuries and socioeconomic status in LMICs. Given the establishment of the IM-DSS research site and its regular, on-going data collection on demographic, health and socioeconomic outcomes, there is a promising opportunity to build upon the proposed study to continue examining the effects of injuries over a longer period of time.

References

1. GBD Mortality, Causes of Death Collaborators. Global, regional, and national age–sex specific all-cause and cause-specific mortality for 240 causes of death, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *The Lancet.*385(9963):117-171.
2. Institute for Health Metrics and Evaluation (IHME). GBD Compare. 2015; http://vizhub.healthdata.org/gbd-compare. . Accessed November 5, 2015.
3. Global Road Safety Facility; The World Bank and Institute for Health Metrics and Evaluation. *Transport for Health: The Global Burden of Disease from Motorized Road Transport.* Sealttle, WA2014.
4. Nguyen H, Ivers R, Jan S, Martiniuk A, Pham C. Catastrophic household costs due to injury in Vietnam. *Injury.* 2012.
5. Xu K, Evans DB, Carrin G, Aguilar-Rivera AM, Musgrove P, Evans T. Protecting households from catastrophic health spending. *Health affairs.* 2007;26(4):972-983.
6. Juillard C, Labinjo M, Kobusingye O, Hyder AA. Socioeconomic impact of road traffic injuries in West Africa: exploratory data from Nigeria. *Inj Prev.* 2010;16(6):389-392.
7. Commission on Social Determinants of Health. *Closing the gap in a generation: health equity through action on the social determinants of health. Final Report of the Commission on Social Determinants of Health.* Geneva: World Health Organization;2008.
8. *WHO Guide to Identifying the Economic Consequences of Disease and Injury.* Gevena, Switzerlind: Department of Health Systems Financing, Health Systems and Services, World Health Organization,;2009.
9. Russell S. The economic burden of illness for households in developing countries: a review of studies focusing on malaria, tuberculosis, and human immunodeficiency virus/acquired immunodeficiency syndrome. *Am J Trop Med Hyg.* 2004;71(2 suppl):147-155.
10. INTERNATIONAL DEVELOPMENT RESEARCH CENTRE. *POPULATION AND HEALTH IN DEVELOPING COUNTRIES: Population, Health, and Survival at INDEPTH Sites, Vol 1.* 2002.
11. Bachani AM, Galiwango E, Kadobera D, et al. A new screening instrument for disability in low-income and middle-income settings: application at the Iganga-Mayuge Demographic Surveillance System (IM-DSS), Uganda. *BMJ Open.* 2014;4(12):e005795.
12. Bachani AM, Hyder AA, Kadobera D, et al. Application of a new instrument to measure injuries and disability at the Iganga-Mayuge demographic surveillance system (im-dss), Uganda. *Injury prevention.* 2012;18(Suppl 1):A92-A92.
13. World Health Organization. *Guidelines for conducting community surveys on injuries and violence.* Geneva, Switzerland 2004.
14. World Bank. *Designing Household Survey Questionnaires for Developing Countries: Lessons from 15 years of the Living Standards Measurement Study.* World Bank;2000.
15. Brislin RW. Back-translation for cross-cultural research. *Journal of cross-cultural psychology.* 1970;1(3):185-216.

16. Sankoh O, Byass P. The INDEPTH Network: filling vital gaps in global epidemiology. *International journal of epidemiology.* 2012;41(3):579-588.
17. Vyas S, Kumaranayake L. Constructing socio-economic status indices: how to use principal components analysis. *Health policy and planning.* 2006;21(6):459-468.
18. Rutstein SO. The DHS Wealth Index: Approaches for rural and urban areas. 2008.
19. Filmer D, Pritchett LH. Estimating wealth effects without expenditure data--or tears: an application to educational enrollments in states of India. *Demography.* 2001;38(1):115-132.
20. Kolenikov S, Angeles G. The use of discrete data in PCA: theory, simulations, and applications to socioeconomic indices. *Chapel Hill: Carolina Population Center, University of North Carolina.* 2004.
21. Galiwango E, Kasunumba N. Personal communication on rural household assets. 2014.
22. Ssewanyana S, Bategeka L. Chronic poverty and economic growth in Uganda: The role of markets. *Chronic Poverty Report.* 2007;8.
23. Uganda Bureau of Statistics. *2002 Uganda Population and Housing Census Analytical Report.* Kampala, Uganda October 2006.
24. Olsson U. Maximum likelihood estimation of the polychoric correlation coefficient. *Psychometrika.* 1979;44(4):443-460.
25. Pearson K. LIII. On lines and planes of closest fit to systems of points in space. *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science.* 1901;2(11):559-572.
26. Howe LD, Hargreaves JR, Huttly SR. Issues in the construction of wealth indices for the measurement of socio-economic position in low-income countries. *Emerg Themes Epidemiol.* 2008;5:3.
27. Browne M, Ortmann G, Hendriks SL. Developing a resilience indicator for food security monitoring and evaluation: Index construction and household classification for six African countries. *Agrekon.* 2014;53(3):31-56.
28. Montgomery MR, Gragnolati M, Burke KA, Paredes E. Measuring living standards with proxy variables. *Demography.* 2000;37(2):155-174.
29. Garenne M, Hohmann-Garenne S. A wealth index to screen high-risk families: application to Morocco. *J Health Popul Nutr.* 2003;21(3):235-242.
30. Peugh JL, Enders CK. Missing data in educational research: A review of reporting practices and suggestions for improvement. *Review of educational research.* 2004;74(4):525-556.
31. Graham JW, Hofer SM, Donaldson SI, MacKinnon DP, Schafer JL. Analysis with missing data in prevention research. *The science of prevention: Methodological advances from alcohol and substance abuse research.* 1997;1:325-366.
32. Schafer JL. Multiple imputation: a primer. *Statistical methods in medical research.* 1999;8(1):3-15.
33. Schafer JL, Graham JW. Missing data: our view of the state of the art. *Psychological methods.* 2002;7(2):147.

34. White IR, Royston P, Wood AM. Multiple imputation using chained equations: Issues and guidance for practice. *Stat Med.* 2011;30(4):377-399.
35. McKelvey RD, Zavoina W. A statistical model for the analysis of ordinal level dependent variables. *Journal of Mathematical Sociology.* 1975;4(1):103-120.
36. Hilbe JM. *Negative binomial regression.* Cambridge University Press; 2011.
37. Barbour AD, Holst L, Janson S. *Poisson approximation.* Clarendon Press Oxford; 1992.
38. Aldrich JH, Nelson FD. *Linear probability, logit, and probit models.* Vol 45: Sage; 1984.
39. Mock CN, Gloyd S, Adjei S, Acheampong F, Gish O. Economic consequences of injury and resulting family coping strategies in Ghana. *Accident; analysis and prevention.* 2003;35(1):81-90.
40. Abegunde DO, Mathers CD, Adam T, Ortegon M, Strong K. The burden and costs of chronic diseases in low-income and middle-income countries. *Lancet.* 2007;370(9603):1929-1938.
41. Chima RI, Goodman CA, Mills A. The economic impact of malaria in Africa: a critical review of the evidence. *Health policy.* 2003;63(1):17-36.
42. Kemp JR, Mann G, Simwaka BN, Salaniponi FM, Squire SB. Can Malawi's poor afford free tuberculosis services? Patient and household costs associated with a tuberculosis diagnosis in Lilongwe. *Bull World Health Organ.* 2007;85(8):580-585.
43. Ettling M, McFarland DA, Schultz LJ, Chitsulo L. Economic impact of malaria in Malawian households. *Trop Med Parasitol.* 1994;45(1):74-79.
44. World Bank. World Development Indicators, The World Bank. 2015; http://databank.worldbank.org/data. Accessed November 9, 2015.
45. Uganda Ministry of Health, Health Systems 20/20, Makerere University School of Public Health. *Uganda Health System Assessment 2011.* Kampala, Uganda and Bethesda, MD April 2012.
46. Nabyonga Orem J, Mugisha F, Kirunga C, Macq J, Criel B. Abolition of user fees: the Uganda paradox. *Health policy and planning.* 2011;26 Suppl 2:ii41-51.
47. Konde-Lule J, Gitta SN, Lindfors A, Okuonzi S, Onama VO, Forsberg BC. Private and public health care in rural areas of Uganda. *BMC Int Health Hum Rights.* 2010;10:29.
48. Debpuur C, Welaga P, Wak G, Hodgson A. Self-reported health and functional limitations among older people in the Kassena-Nankana District, Ghana. *Glob Health Action.* 2010;3.
49. Mwanyangala MA, Mayombana C, Urassa H, et al. Health status and quality of life among older adults in rural Tanzania. *Glob Health Action.* 2010;3.
50. Xavier Gomez-Olive F, Thorogood M, Clark BD, Kahn K, Tollman SM. Assessing health and well-being among older people in rural South Africa. *Glob Health Action.* 2010;3.
51. Duff P, Rubaale T, Kipp W. Married men's perceptions of barriers for HIV-positive pregnant women accessing highly active antiretroviral therapy in rural Uganda. *Int J Womens Health.* 2012;4:227-233.

52. Lloyd CB, Blanc AK. Children's schooling in sub-Saharan Africa: The role of fathers, mothers, and others. *Population and development review.* 1996:265-298.
53. Mock C, Acheampong F, Adjei S, Koepsell T. The effect of recall on estimation of incidence rates for injury in Ghana. *International journal of epidemiology.* 1999;28(4):750-755.
54. Siedner MJ, Lankowski A, Tsai AC, et al. GPS-measured distance to clinic, but not self-reported transportation factors, are associated with missed HIV clinic visits in rural Uganda. *Aids.* 2013;27(9):1503-1508.
55. Somi MF, Butler JR, Vahid F, Njau JD, Kachur SP, Abdulla S. Use of proxy measures in estimating socioeconomic inequalities in malaria prevalence. *Tropical Medicine & International Health.* 2008;13(3):354-364.
56. Ministry of Health. *Health Sector Strategic Plan III: 2010/11 - 2014/2015.* Kampala, Uganda: Government of Uganda;2010.
57. Hsia RY, Ozgediz D, Mutto M, Jayaraman S, Kyamanywa P, Kobusingye OC. Epidemiology of injuries presenting to the national hospital in Kampala, Uganda: implications for research and policy. *International journal of emergency medicine.* 2010;3(3):165-172.
58. Jayaraman S, Mabweijano JR, Lipnick MS, et al. First things first: effectiveness and scalability of a basic prehospital trauma care program for lay first-responders in Kampala, Uganda. *PloS one.* 2009;4(9):e6955.
59. Organization WH. CBR: A Strategy for Rehabilitation, Equalization of Opportunities, Poverty Reduction and, Social Inclusion of People With Disabilities. 2004.
60. Penny N, Zulianello R, Dreise M, Steenbeek M. Community-based rehabilitation and orthopaedic surgery for children with motor impairment in an African context. *Disabil Rehabil.* 2007;29(11-12):839-843.
61. Cohen M, McCord MJ, Sebstad J. Reducing vulnerability: demand for and supply of microinsurance in East Africa. *Journal of International Development.* 2005;17(3):319-325.
62. Brody CM, Bellows N, Campbell M, Potts M. The impact of vouchers on the use and quality of health care in developing countries: a systematic review. *Glob Public Health.* 2013;8(4):363-388.
63. Bellows NM, Bellows BW, Warren C. Systematic Review: the use of vouchers for reproductive health services in developing countries: systematic review. *Tropical medicine & international health : TM & IH.* 2011;16(1):84-96.
64. Lagomarsino G, Garabrant A, Adyas A, Muga R, Otoo N. Moving towards universal health coverage: health insurance reforms in nine developing countries in Africa and Asia. *Lancet.* 2012;380(9845):933-943.
65. Barimah KB, Mensah J. Ghana's National Health Insurance Scheme: insights from members, administrators and health care providers. *J Health Care Poor Underserved.* 2013;24(3):1378-1390.
66. Mensah J, Oppong JR, Schmidt CM. Ghana's National Health Insurance Scheme in the context of the health MDGs: an empirical evaluation using propensity score matching. *Health Econ.* 2010;19 Suppl:95-106.

67. Xu K, Evans DB, Carrin G, Aguilar-Rivera AM, Musgrove P, Evans T. Protecting households from catastrophic health spending. *Health affairs.* 2007;26(4):972-983.

TABLE 1. Select variables from IM-DSS core demographic data and socioeconomic data

Variable	Response examples
Demographic	
Name of new born child	Qualitative
Name of deceased	Qualitative
Age of deceased	Numeric
Sex of usual household resident	Female/male
Year of birth of usual household resident	Numeric
Marital status of resident	Single, married, separated/divorced, co-habit, widowed
Names of persons who usually live in the household	Qualitative
Relationship of usual residents to the household head	Household head, wife, child, parent, grandparent, sister, uncle, not related
Did usual resident sleep in household last night	Yes/no
Did usual resident, who did not sleep in household last night, leave the household less than four months ago	Yes/no
Reason for individual's change in residence	Family related, security related, housing related, job related, cost related, education related
Relationship between household in-migrant and household head	Household head, wife, child, parent, grandparent, sister, uncle, not related
Sex of household in-migrant	Female/male
Basic reason for household in-migration	Build or form a new household Join an existing household
Reason for household in-migration	Family related, security related, housing related, job related, cost related, education related
Socioeconomic	
Formal employment of the head of household	Agriculture, trade, formal employment, laborer (wage earner), remittances, fishing, other
Occupation of the head of household	Shop/business, bodaboda/taxi, professional, farmer/agriculture, market vender, laborer (wage), mechanical work, other
Main source of drinking water	Taps, tanks, piped water into residence/compound/plot, well on residence/plot, unprotected spring, borehole

Variable	Response examples
Type of dwelling	Independent house, basement, shared house, hut
Main roof material	Grass thatched, plastic sheet, carbonated sheets, wood/timber, metal sheets, iron sheets, tiles, cement, other
Total number of rooms	Quantitative
Owns cattle	Yes/no

TABLE 2. Variables for Analyses

Variable	Values
Sociodemographic	
Sex	Binary variable for male and female
Age	Continuous
Relationship to household head	Categorical variable where responses include brother, other, parent-in-law, sister, not related, wife, parent, grandparent, husband, brother-in-law, unknown relationship, child, sister-in-law, grandchild, son-in-law, daughter-in-law, co-wife, self, aunt, nephew, niece, step child, step parent, and uncle
Occupation of the head of household	Categorical variable where responses include shop/business, bodaboda/taxi, professional, farmer/agriculture, market vender, laborer (wage), mechanical work, and other
Household socioeconomic status	Numerous categorical and numerical asset variables
Household location	Categorical variable uniquely identifying household's village location
Injury	
Cause of injury	Categorical variable where responses include traffic; pedestrian; occupant; cyclist; unintentional fall; burn; gun shot; stab; blunt injury; poisoning; drowning; dog, snake or other animal bite; landmine; other causes
Type of most recent injury	Categorical where responses include road or traffic injury, intentional violence-related injury, poisoning, burns, drowning or near drowning, dog, snake, or animal bite, unintentional fall, and other
Ability to resume usual activities	One categorical variable on length of inability to resume activity among those who were unable to resume for more than one day, where responses include between one to six days, between one to four weeks, and for more than on month
Time since injury	Three numeric variables on reported date, month, and year of injury
Hospital admission	Binary variable for whether the injured was admitted to the facility
Surgery	Binary variable for whether injury required surgery
Cost	Numerical variable on cost of transport to initial care
Ability to return to previous occupation	Categorical variable where responses include yes, no, and don't know
Number of work days	Continuous

Table 3. Assets selected for the asset index as a measure of household wealth

Asset variable	Type of Asset Index ("X" indicates inclusion)		
	Principal Components Analysis		Simple Sum of Assets
	Type of Correlation		
	Polychoric	Pearson's	
Material			
Roof	X		X
Wall	X	X	X
Floor	X	X	X
Total number			
Rooms	X		X
Sleeping rooms	X	X	X
Main source			
Light	X		X
Toilet			
Drinking water			
Garbage disposal			
Availability			
Shutters			
Handwashing facility			
Owns			
Land			
Mattress	X		X
Table	X		X
Bednet	X		X
Gas or electric cooker			
Kerosene stove	X		X
Charcoal iron	X	X	X
Electric iron	X		X
Television set	X		X
Radio	X	X	X
Mobile phone	X		X
Stereo	X		X
Phone			
Camera	X		X
Motorcycle	X		X
Bicycle	X	X	X
Car			
Refrigerator	X		X
Sewing machine	X	X	X
Panga	X		X
Wheelbarrow	X	X	X
Plough	X		X
Axe	X		X
Cattle	X		X

Sheep	X	X
Goat	X	X
Chicken	X	X
Pig		
Quantity currently in storage		
Maize		
Beans		
Millet		
Groundnuts		
Rice		
Cassava		
Stores food	X	X

Table 4. Recoding categorical asset variables for wealth index based on simple sum of assets

	Asset variable	Variable Coding for Asset Index: Principal Components Analysis	Variable Coding for Asset Index: Simple Sum of Assets
Material			
Roof	Grass, thatched, or plastic	1	0
	Wood or timber	2	
	Carbonated, metal or iron sheets	3	1
	Asbestos, tiles, or cement	4	
Wall	Mud, poles, or thatched	1	0
	Iron, carbonated, or metal sheets or unburnt bricks	2	
	Burnt bricks or cement blocks	3	1
	Wood or timber	4	
Floor	Earth or earth and dung	1	0
	Sand or gravel	2	
	Cement or wood planks	3	1
Total number			
Rooms	One	1	0
	Two	2	
	Three to ten	3	1
	Eleven or more	4	
Sleeping rooms	One	1	0
	Two	2	
	Three to ten	3	1
	Eleven or more	4	
Main source of light			
	Firewood	1	0
	Paraffin or wax candle	2	
	Paraffin or kerosene lantern	3	1
	Solar or electricity	4	

Table 5. Model specification for study outcomes

Outcome	Type of variable	Model specification
Hours spent traveling to initial care	Ordinal	Ordered logit
Cost of transportation to initial care (USD)	Count	Negative binomial
Cost of initial care services (USD	Count	Negative binomial
Ability to return to occupation following the injury	Binary	Logit
Number of work days lost	Count	Negative binomial
Number of school days missed	Count	Negative binomial

Table 6. Injured characteristics by household's village development (n=749)

	% (No.) Peri-urban	Rural	Pearson χ2 statistic (p-value)
Gender			
Female	37.8 (31)	36.9 (246)	0.03 (0.87)
Male	62.2 (51)	63.1 (421)	
Age (years)			
Under five	11 (9)	10.2 (68)	2.7 (0.743)
Five to <15	23.2 (19)	26.5 (177)	
15 to <30	28 (23)	21.4 (143)	
30 to <45	19.5 (16)	18.7 (125)	
45 to <60	9.8 (8)	13.6 (91)	
60 and older	8.5 (7)	9.4 (63)	
Occupation			
Not earning income	42.7 (35)	48.3 (322)	57.8 (<0.0001)
Professional or shop/business	18.3 (15)	6.4 (43)	
Bodaboda/taxi	2.4 (2)	7.9 (53)	
Farmer/Agriculture	4.9 (4)	24.7 (165)	
Vendor	18.3 (15)	4 (27)	
Mechanical/construction	7.3 (6)	4.5 (30)	
Laborer	6.1 (5)	4 (27)	
Household head occupation (n=738)*			
Professionals	14.1 (11)	4.8 (32)	102.2 (<0.0001)
Shop/business	53.8 (42)	14.5 (96)	
Bodaboda drivers	5.1 (4)	8.3 (55)	
Farmer/agriculture	1.3 (1)	45.5 (300)	
Mechanical, vender, laborer	17.9 (14)	18 (119)	
Household head sex (n=738)*			
Male	77.9 (60)	82.6 (537)	1.03 (0.31)
Female	22.1 (17)	17.4 (113)	

* Smaller sample sizes are due to missing data

** Chi square tests were not run on contingency tables where more than 20% of expected counts are less than five or where at least one cell has an expected count less than one

Table 7. Sample characteristics in the rural IM-DSS sample (n=643)

	% (No.)
Gender	
Female	37.0 (238)
Male	63.0 (405)
Age (years) (n=625)*	
Under five	8.2 (51)
Five to <15	27.4 (171)
15 to <30	21.8 (136)
30 to <45	18.9 (118)
45 to <60	13.9 (87)
60 and older	9.9 (62)
Occupation	
Shop/business	5.4 (35)
Bodaboda/taxi	7.9 (51)
Professional	1.2 (8)
Farmer/Agriculture	24.7 (159)
Vendor	4.0 (26)
Laborer	3.6 (23)
Mechanical	0.9 (6)
Construction	3.7 (24)
Student	36.9 (237)
Homemaker	0.8 (5)
Unemployed	1.7 (11)
Preschool child	8.7 (56)
Relationship to household head	
Child or grandchild	50.9 (327)
Household head	10.6 (68)
Wife	3.7 (24)
Other	34.8 (224)
Household head occupation (n=636)*	
Shop/Business	14.8 (94)
Bodaboda/Taxi	8.2 (52)
Professional	4.9 (31)
Farmer/Agriculture	45.6 (290)
Market vender	0.6 (4)
Laborer	14.5 (92)
Mechanical work	2.8 (18)
Other	8.6 (55)
Household head sex (n=643)	
Male	82.3 (516)
Female	17.7 (111)
PCA-based wealth quintile (n=549)*	
Highest (wealthiest)	24.2 (133)
Second highest	29 (159)
Middle	16.6 (91)
Second lowest	17.9 (98)
Lowest (poorest)	12.4 (68)
Simple sum of assets-based wealth quintile (n=549)*	
Highest (wealthiest)	24.6 (135)
Second highest	24 (132)

	% (No.)
Middle	15.5 (85)
Second lowest	20.6 (113)
Lowest (poorest)	15.3 (84)

* Smaller sample sizes are due to missing data

TABLE 8. Injury and care characteristics in the rural IM-DSS sample (n=643)

	% (No.)
Type of injury	
Road traffic injury	44.0 (283)
Unintentional fall	27.7 (178)
Burn	9.6 (62)
Intentional violence-related	5.4 (35)
Stab or cut	7.6 (49)
Animal bite	2.5 (16)
Blunt	2.0 (13)
Poisoning	1.1 (7)
Months elapsed between injury event and date of interview	
Less than three	6.8 (44)
Three to six	11.4 (73)
Six to 12	22.2 (143)
12 to 18	8.1 (52)
18 to 24	20.8 (134)
24 to 36	30.6 (197)
Type of transport to care site (n=637)	
Motorcycle	39.6 (255)
Bicycle	34.4 (219)
By foot	11.9 (76)
No transported/stayed at scene	9.5 (61)
Ambulance	1.3 (8)
Personal vehicle	1.1 (7)
Other	2 (13)
Don't know	0.5 (3)
Where first time care was received	
Hospital	35.3 (227)
Private clinic	34.5 (222)
Traditional practitioner	17 (109)
Health center	6.8 (44)
Pharmacy/drug store	3.7 (24)
Home	2 (13)
Other	0.8 (5)

* Smaller sample sizes are due to missing data

TABLE 9. Direct socioeconomic consequences of the most recent injury in the rural IM-DSS sample (n=643)

	Mean	95% Confidence interval	Standard deviation
		% (No.)	
Hours spent traveling to first time care among those who traveled to seek care after the injury scene (n=623)			
Less than one		64.3 (399)	
One to less than three		25.3 (157)	
More than three		10.5 (65)	
Money spent on seeking first time care	**Mean**	**95% Confidence interval**	**Standard deviation**
Transportation among those who traveled to seek care (n=519) †	0.4	(0.32, 0.48)	1.14
Care services (n=601)*	6.9	(5.61, 8.17)	16.00
		% (No.)	
Able to return to one's occupation following the injury among the employed (n=334)			
Yes		89.5 (299)	
No		10.5 (35)	
	Mean	**Confidence interval**	**Standard deviation**
Number of days lost due to the injury			
Work days among those employed at the time of the injury and able to return to occupation (n=299)	30.9	(25.56, 36.21)	45.89
School days among those who were students at the time of the injury (n=288)	20.6	(15.94, 25.30)	35.87

* Smaller sample sizes are due to missing data.

† Excluding 75 individuals who travelled to the site of care by foot and 20 who sought care from a source in the "other" category (19 went to a pharmacy or drug store and one sought *kugemamu*, a type of massage)

Table 9. Rural IM-DSS proportional odds ratios for increase in time spent travelling from the site of the most recent injury to first time care by sociodemographic and injury characteristics (n=621)

Variable	Unadjusted			Adjusted*		
	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
Sex						
Female	1.0			1.0		
Male	0.84	(0.57, 1.24)	0.377	0.94	(0.58, 1.51)	0.792
Age group at the time of the injury						
Under 15	1.0			1.0		
15 to <30	1.36	(0.95, 1.95)	0.093	1.64	(0.93, 2.88)	0.087
30 to <45	0.97	(0.56, 1.7)	0.922	1.5	(0.67, 3.34)	0.322
45 to <60	1.57	(0.95, 2.59)	0.079	2.16	(1.02, 4.58)	0.045
Over 60	2.25	(1.42, 3.56)	0.001	3.26	(1.37, 7.75)	0.008
Occupation						
Not earning income	1.0			1.0		
Professional or shop/business	1.39	(0.74, 2.61)	0.313	0.87	(0.38, 1.99)	0.734
Bodaboda/taxi	0.58	(0.3, 1.12)	0.107	0.41	(0.18, 0.94)	0.034
Farmer/agriculture	1.19	(0.75, 1.89)	0.472	0.76	(0.34, 1.67)	0.49
Mechanical work, construction, vendor, or laborer	1.22	(0.78, 1.91)	0.38	0.8	(0.43, 1.47)	0.464
Household head occupation						
Professionals or shop/business	1.0			1.0		
Bodaboda/taxi drivers	0.58	(0.3, 1.12)	0.107	0.94	(0.43, 2.09)	0.888
Farmer/Agriculture	0.83	(0.51, 1.33)	0.43	0.9	(0.56, 1.44)	0.653
Mechanical work, vender, or laborer	1.01	(0.66, 1.56)	0.955	1.1	(0.7, 1.75)	0.674
Other	0.89	(0.47, 1.67)	0.707	0.93	(0.48, 1.79)	0.82
Wealth quintile						
Highest	1.0			1.0		
Second highest	0.78	(0.52, 1.18)	0.246	0.86	(0.57, 1.29)	0.457
Middle	0.58	(0.32, 1.05)	0.073	0.61	(0.33, 1.12)	0.107
Second lowest	0.74	(0.41, 1.35)	0.325	0.89	(0.46, 1.71)	0.719
Lowest	0.56	(0.3, 1.05)	0.069	0.59	(0.27, 1.28)	0.183

Variable	Unadjusted			Adjusted*		
	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
Household head sex						
Male	1.0			1.0		
Female	1.21	(0.79, 1.84)	0.39	1.17	(0.68, 2.02)	0.564
Type of injury						
Unintentional fall	1.0			1.0		
Road traffic injury	0.88	(0.63, 1.21)	0.419	0.52	(0.33, 0.84)	0.007
Other	1.18	(0.78, 1.78)	0.436	0.78	(0.45, 1.35)	0.376
Months elapsed since injury						
Less than six	1.0			1.0		
Six to <12	0.82	(0.37, 1.82)	0.624	0.6	(0.28, 1.28)	0.185
12 to <24	0.95	(0.5, 1.79)	0.876	0.78	(0.4, 1.53)	0.479
24 to 36	0.85	(0.48, 1.48)	0.558	0.71	(0.4, 1.27)	0.247
Mode of transportation						
Motorcycle	1.0			1.0		
Bicycle	0.94	(0.63, 1.4)	0.762	1.15	(0.72, 1.83)	0.567
By foot	0.23	(0.12, 0.45)	<0.0001	0.29	(0.14, 0.6)	0.001
Four wheel motorized vehicle	1.76	(1.19, 2.59)	0.005	1.53	(0.99, 2.37)	0.054
Source of first time care						
Traditional practitioner	1.0			1.0		
Private clinic	1.73	(1.17, 2.55)	0.006	1.6	(0.77, 3.33)	0.206
Health center	0.92	(0.29, 2.91)	0.892	1.21	(0.35, 4.23)	0.761
Hospital	1.37	(0.75, 2.52)	0.303	3.29	(1.43, 7.57)	0.005
Other	0.23	(0.12, 0.44)	<0.0001	1.13	(0.32, 4.03)	0.851
Duration of time respondent was unable to resume usual activities						
One to six days	1.0			1.0		
1-4 weeks	0.88	(0.53, 1.44)	0.606	0.77	(0.51, 1.18)	0.231
Unable for > 1 month	0.65	(0.41, 1.02)	0.059	0.52	(0.33, 0.81)	0.004

*Odds ratios adjusted for all variables listed in the table

Table 10. Rural IM-DSS incidence rate ratios for money spent on transport to first time care (excluding walking) after the scene of the most recent injury to by sociodemographic and injury characteristics (n=506)

Variable	Unadjusted			Adjusted*		
	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
Sex						
Female	1.0			1.0		
Male	1.04	(0.69, 1.55)	0.865	0.87	(0.65, 1.18)	0.377
Age group at the time of the injury						
Under 15	1.0			1.0		
15 to <30	1.35	(0.91, 2.01)	0.14	1.07	(0.73, 1.58)	0.717
30 to <45	1.69	(0.83, 3.45)	0.151	1.04	(0.69, 1.57)	0.859
45 to <60	1.14	(0.7, 1.85)	0.605	0.82	(0.49, 1.37)	0.445
Over 60	1.7	(0.85, 3.42)	0.133	0.98	(0.55, 1.73)	0.938
Wealth quintile						
Highest	1.0			1.0		
Second highest	1.21	(0.69, 2.13)	0.508	1.37	(0.95, 1.97)	0.095
Middle	0.84	(0.41, 1.7)	0.621	0.91	(0.55, 1.53)	0.733
Second lowest	0.49	(0.27, 0.92)	0.026	0.97	(0.6, 1.56)	0.899
Lowest	0.67	(0.37, 1.22)	0.193	1.28	(0.74, 2.22)	0.38
Household head sex						
Male	1.0			1.0		
Female	0.84	(0.51, 1.4)	0.512	0.94	(0.62, 1.41)	0.759
Type of injury						
Unintentional fall	1.0			1.0		
Road traffic injury	0.96	(0.52, 1.75)	0.886	0.58	(0.35, 0.96)	0.034
Other	1.77	(0.94, 3.32)	0.075	1.17	(0.74, 1.86)	0.504
Months elapsed since injury						
Less than six	1.0			1.0		
Six to <12	2.71	(1.65, 4.46)	<0.0001	1.84	(1.16, 2.92)	0.01
12 to <24	1.53	(0.99, 2.38)	0.058	1.24	(0.8, 1.93)	0.331
24 to 36	1.55	(0.98, 2.44)	0.058	1.31	(0.87, 1.99)	0.201

Variable	Unadjusted Odds Ratio	Unadjusted 95% CI	Unadjusted p-value	Adjusted* Odds Ratio	Adjusted* 95% CI	Adjusted* p-value
Mode of transportation						
Motorcycle	1.0			1.0		
Bicycle	0.11	(0.07, 0.19)	<0.0001	0.11	(0.06, 0.19)	<0.0001
Four wheel motorized vehicle	2.72	(1.63, 4.54)	<0.0001	2.06	(1.46, 2.9)	<0.0001
Hours spent traveling to first time						
Less than one	1.0			1.0		
One to less than three	1.83	(1.28, 2.62)	0.001	1.19	(0.87, 1.63)	0.265
More than three	1.61	(0.91, 2.84)	0.1	1.4	(0.89, 2.2)	0.142
Source of first time care						
Traditional practitioner	1.0			1.0		
Private clinic	0.67	(0.37, 1.2)	0.179	0.63	(0.32, 1.21)	0.162
Health center	0.81	(0.34, 1.93)	0.631	0.99	(0.44, 2.2)	0.974
Hospital	2.49	(1.51, 4.1)	<0.0001	1.1	(0.64, 1.87)	0.737
Duration of time respondent was unable to resume usual activities						
One to six days	1.0			1.0		
1-4 weeks	1.52	(0.94, 2.43)	0.085	1.03	(0.72, 1.48)	0.864
Unable for > 1 month	3.17	(1.71, 5.89)	<0.0001	1.69	(1.11, 2.56)	0.013

*Odds ratios adjusted for all variables listed in the table

Table 11. Rural IM-DSS incidence rate ratios for money (USD) spent on first time care after the scene of the most recent injury by sociodemographic and injury characteristics (n=601)

Variable	Unadjusted			Adjusted*		
	Incidence Rate Ratio	95% CI	p-value	Incidence Rate Ratio	95% CI	p-value
Sex						
Female	1.0			1.0		
Male	1.14	(0.78, 1.68)	0.498	1.24	(1.02, 1.52)	0.03
Age group at the time of the injury						
Under 15	1.0			1.0		
15 to <30	2.04	(1.33, 3.14)	0.001	1.21	(0.91, 1.62)	0.187
30 to <45	2.35	(1.64, 3.37)	<0.0001	1.18	(0.89, 1.57)	0.245
45 to <60	1.43	(0.95, 2.15)	0.083	1.02	(0.75, 1.38)	0.913
Over 60	2.94	(1.41, 6.15)	0.004	1.37	(0.96, 1.94)	0.079
Household head occupation						
Professionals or shop/business	1.0			1.0		
Bodaboda/taxi drivers	1.6	(0.89, 2.88)	0.115	1.37	(0.86, 2.17)	0.181
Farmer/Agriculture	0.94	(0.63, 1.39)	0.752	1.01	(0.78, 1.31)	0.912
Mechanical work, vender, or laborer	0.89	(0.54, 1.49)	0.662	1.02	(0.75, 1.39)	0.891
Other	1.33	(0.43, 4.1)	0.616	1.01	(0.66, 1.53)	0.974
Wealth quintile						
Highest	1.0			1.0		
Second highest	1.31	(0.77, 2.23)	0.315	1.08	(0.79, 1.49)	0.623
Middle	1.22	(0.74, 2.01)	0.44	1	(0.72, 1.39)	0.995
Second lowest	0.62	(0.4, 0.96)	0.032	0.85	(0.58, 1.25)	0.42
Lowest	0.88	(0.47, 1.64)	0.68	0.87	(0.55, 1.38)	0.548
Household head sex						
Male	1.0			1.0		
Female	1.26	(0.67, 2.37)	0.465	1.27	(0.93, 1.75)	0.133
Type of injury						
Unintentional fall	1.0			1.0		

Variable	Unadjusted			Adjusted*		
	Incidence Rate Ratio	95% CI	p-value	Incidence Rate Ratio	95% CI	p-value
Road traffic injury	2.38	(1.68, 3.37)	<0.0001	1.15	(0.91, 1.45)	0.24
Other	1.62	(1.12, 2.33)	0.01	1.04	(0.8, 1.34)	0.773
Months elapsed since injury						
Less than six	1.0			1.0		
Six to <12	1.55	(0.9, 2.67)	0.116	1.84	(1.16, 2.92)	0.01
12 to <24	1.09	(0.71, 1.68)	0.691	1.24	(0.8, 1.93)	0.331
24 to 36	1.46	(0.88, 2.42)	0.141	1.31	(0.87, 1.99)	0.201
Source of first time care						
Traditional practitioner	1.0			1.0		
Other	0.7	(0.36, 1.36)	0.292	0.89	(0.52, 1.53)	0.677
Private clinic	1.58	(1.18, 2.11)	0.002	2.02	(1.52, 2.7)	<0.0001
Health center	1.11	(0.66, 1.84)	0.699	1.46	(0.81, 2.63)	0.209
Hospital	4.46	(3.25, 6.12)	<0.0001	4.07	(3.09, 5.35)	<0.0001
Duration of time respondent was unable to resume usual activities						
One to six days	1.0			1.0		
1-4 weeks	2.12	(1.58, 2.85)	<0.0001	1.92	(1.46, 2.54)	<0.0001
Unable for > 1 month	6.05	(3.86, 9.48)	<0.0001	4.57	(3.16, 6.61)	<0.0001

*Odds ratios adjusted for all variables listed in the table

Table 12. Rural IM-DSS odds ratios for inability to return to occupation following the most recent injury (n=334)

Variable	Unadjusted			Adjusted*		
	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
Sex						
Female	1.0			1.0		
Male	1.76	(0.72, 4.26)	0.213	1.41	(0.57, 3.49)	0.461
Age group at the time of the injury						
Under 30	1.0			1.0		
30 to <45	0.55	(0.21, 1.42)	0.218	0.53	(0.2, 1.43)	0.209
Over 45	1.08	(0.44, 2.68)	0.867	1.58	(0.53, 4.69)	0.409
Occupation						
Professional, shop/business, or bodaboda/taxi driver	1.0			1.0		
Farmer/agriculture	0.46	(0.18, 1.17)	0.102	0.28	(0.09, 0.81)	0.019
Mechanical work, construction, vendor, or laborer	0.98	(0.41, 2.37)	0.963	1.03	(0.41, 2.58)	0.947
Wealth tertile						
Rich	1.0			1.0		
Middle	0.83	(0.35, 1.96)	0.67	0.84	(0.29, 2.46)	0.749
Poor	1.7	(0.66, 4.34)	0.27	2.47	(0.87, 7)	0.09
Household head sex						
Male	1.0			1.0		
Female	0.96	(0.45, 2.04)	0.911	1.13	(0.44, 2.92)	0.799
Type of injury						
Unintentional fall	1.0			1.0		
Road traffic injury	0.97	(0.34, 2.73)	0.952	1.13	(0.35, 3.63)	0.841
Other	0.67	(0.24, 1.87)	0.448	1.14	(0.32, 4.05)	0.836
Months elapsed since injury						
Less than 12	1.0			1.0		
12 to <24	1	(0.42, 2.39)	1	1.32	(0.54, 3.26)	0.544
24 to 36	1.96	(0.73, 5.23)	0.181	2.31	(0.75, 7.14)	0.145

Variable	Unadjusted			Adjusted*		
	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
Duration of time respondent was unable to resume usual activities						
Less than a month	1.0			1.0		
One month or more	8.48	(4.04, 17.78)	<0.0001	10.64	(4.99, 22.65)	<0.0001

*Odds ratios adjusted for all variables listed in the table

Table 13. Rural IM-DSS incidence rate ratios for work days lost following the most recent injury by sociodemographic and injury characteristics among those employed and able to return to their occupations (n=288)

Variable	Unadjusted			Adjusted*		
	Incidence Rate Ratio	95% CI	p-value	Incidence Rate Ratio	95% CI	p-value
Sex						
Female	1.0			1.0		
Male	1.09	(0.76, 1.56)	0.636	1.18	(0.81, 1.7)	0.395
Age group at the time of the injury						
Under 30	1.0			1.0		
30 to <45	1.32	(0.88, 1.98)	0.176	0.88	(0.56, 1.38)	0.564
Over 45	1.65	(1.07, 2.54)	0.023	1.16	(0.73, 1.83)	0.526
Occupation						
Professional, shop/business, or bodaboda/taxi driver	1.0			1.0		
Farmer/agriculture	1.25	(0.83, 1.86)	0.284	1.05	(0.7, 1.59)	0.81
Mechanical work, construction, vendor, or laborer	0.74	(0.51, 1.09)	0.13	0.79	(0.49, 1.29)	0.351
Wealth quintile						
Highest	1.0			1.0		
Second highest	1.15	(0.67, 1.98)	0.616	0.82	(0.57, 1.18)	0.279
Middle	0.9	(0.54, 1.5)	0.686	1.03	(0.66, 1.6)	0.898
Second lowest	0.59	(0.35, 0.98)	0.043	1.51	(0.81, 2.83)	0.199
Lowest	1	(0.59, 1.69)	0.998	1.54	(0.82, 2.91)	0.179

Variable	Unadjusted Incidence Rate Ratio	Unadjusted 95% CI	Unadjusted p-value	Adjusted* Incidence Rate Ratio	Adjusted* 95% CI	Adjusted* p-value
Household head sex						
Male	1.0			1.0		
Female	0.91	(0.55, 1.5)	0.701	0.74	(0.48, 1.14)	0.169
Type of injury						
Unintentional fall	1.0			1.0		
Road traffic injury	0.68	(0.43, 1.07)	0.098	0.88	(0.56, 1.38)	0.575
Other	0.66	(0.38, 1.14)	0.138	1.06	(0.61, 1.84)	0.83
Duration of time respondent was unable to resume usual activities						
Less than a month	1.0			1.0		
One month or more	5.49	(4.34, 6.95)	<0.0001	3.96	(2.89, 5.43)	<0.0001

*Odds ratios adjusted for all variables listed in the table\

TABLE 14. Rural IM-DSS incidence rate ratios for school days lost following the most recent injury by sociodemographic and injury characteristics among students (n=228)

Variable	Unadjusted			Adjusted*		
	Incidence Rate Ratio	95% CI	p-value	Incidence Rate Ratio	95% CI	p-value
Sex						
Female	1.0			1.0		
Male	1.29	(0.84, 1.97)	0.252	1.35	(0.86, 2.11)	0.191
Age group at the time of the injury						
Under 15	1.0			1.0		
Over 15	0.99	(0.61, 1.6)	0.955	1.3	(0.84, 2.02)	0.243
Wealth tertile						
Rich	1.0			1.0		
Middle	0.89	(0.55, 1.43)	0.618	0.98	(0.63, 1.52)	0.918
Poor	1.08	(0.47, 2.49)	0.85	1.04	(0.57, 1.9)	0.89
Household head sex						
Male	1.0			1.0		
Female	0.65	(0.42, 1.03)	0.066	0.62	(0.4, 0.95)	0.028
Type of injury						
Unintentional fall	1.0			1.0		
Road traffic injury	1.05	(0.57, 1.94)	0.864	1.18	(0.74, 1.86)	0.487
Other	1.27	(0.8, 2.01)	0.309	1.6	(0.95, 2.68)	0.076
Duration of time respondent was unable to resume usual						

Variable	Unadjusted			Adjusted*		
	Incidence Rate Ratio	**95% CI**	**p-value**	**Incidence Rate Ratio**	**95% CI**	**p-value**
activities						
Less than a month	1.0			1.0		
One month or more	7.14	(5.22, 9.76)	<0.0001	6.13	(4.19, 8.96)	<0.0001

*Odds ratios adjusted for all variables listed in the table

Table 15. Associations between socioeconomic consequences and household wealth as measured through a simple sum of assets approach

Socioeconomic consequence	Magnitude of Adjusted Wealth Association* (95% CI) p-value				
	Wealth Quintiles				
	Highest	Second highest	Middle	Second Lowest	Lowest
	Proportional Odds Ratio				
Increase in time spent traveling to initial care	1.0	0.94 (0.57, 1.55) 0.809	0.73 (0.39, 1.35) 0.309	0.86 (0.43, 1.75) 0.307	0.76 (0.37, 1.54) 0.608
	Incidence Rate Ratio				
Money spent traveling to initial care	1.0	1.16 (0.77, 1.75) 0.464	1.03 (0.67, 1.58) 0.892	0.63 (0.39, 1.03) 0.065	0.87 (0.52, 1.44) 0.585
	Incidence Rate Ratio				
Money spent on initial carea	1.0	1.2 (0.84, 1.71) 0.309	1 (0.71, 1.4) 0.992	1.04 (0.73, 1.48) 0.846	0.91 (0.58, 1.44) 0.693
Number of weeks spent with functional limitation	Percent change in the probability of reporting the specified time spent with functional limitation				
Less than one	1.0	-0.028 (-0.146, 0.091) 0.644	-0.103 (-0.205, -0.001) 0.047	-0.001 (-0.114, 0.112) 0.986	-0.034 (-0.151, 0.084) 0.573
One to four	1.0	0.022 (-0.128, 0.172) 0.771	0.002 (-0.125, 0.128) 0.979	-0.029 (-0.168, 0.11) 0.684	0.001 (-0.131, 0.134) 0.984
More than four	1.0	0.006 (-0.115, 0.126) 0.927	0.101 (-0.013, 0.216) 0.082	0.03 (-0.093, 0.153) 0.634	0.032 (-0.079, 0.144) 0.57

			Incidence Rate Ratio		
Number of work days lost among those who returned to his or her occupation	1.0	0.97 (0.65, 1.43) 0.859	0.99 (0.65, 1.43) 0.859	1.15 (0.7, 1.88) 0.577	2.16 (1.22, 3.85) 0.009

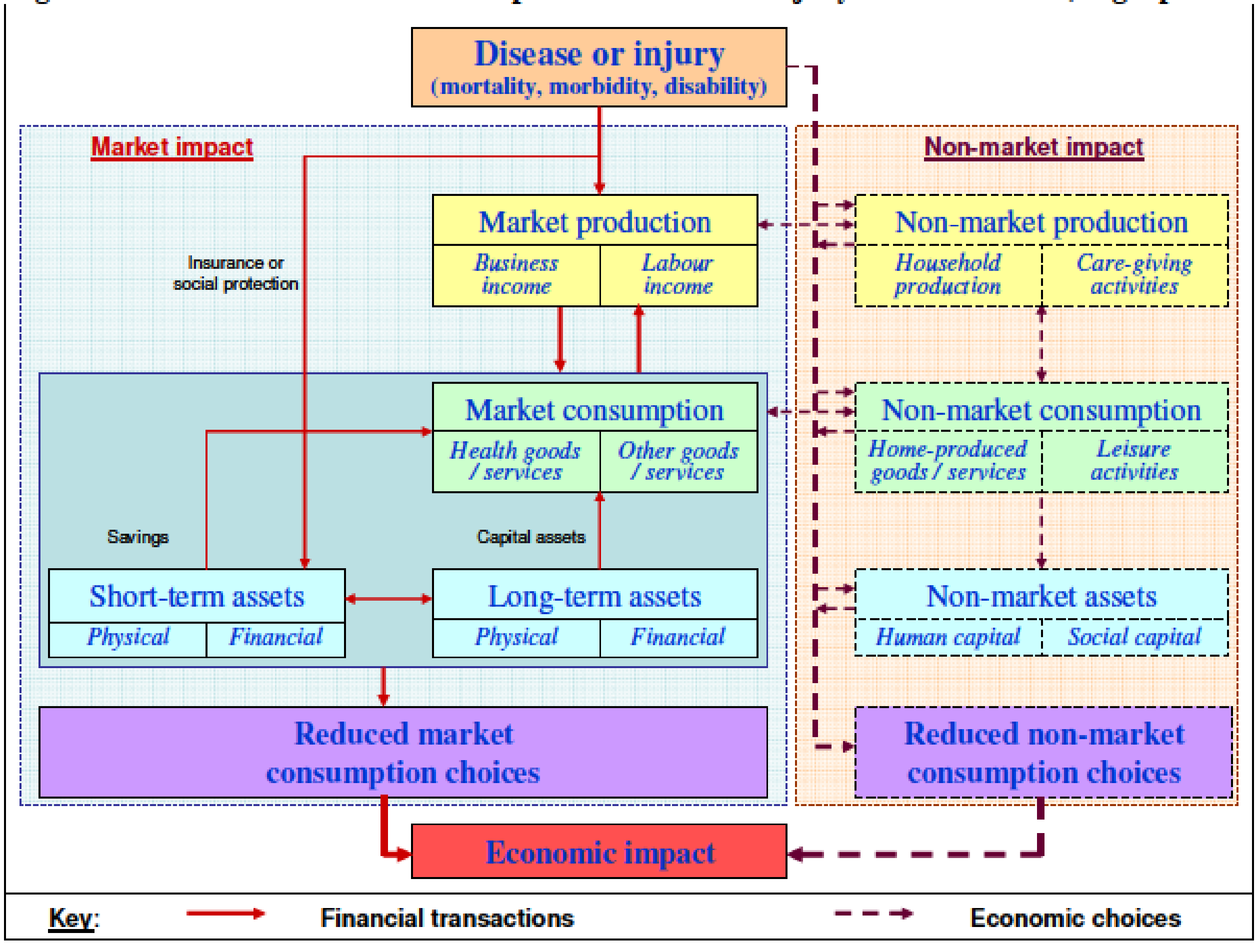
		Wealth Tertiles	
	Rich	**Middle**	**Poor**
		Odds Ratio	
Unable to return to occupation following the injury	1.0	1.27 (0.42, 3.88) 0.674	2.72 (0.78, 9.49) 0.116
		Incidence Rate Ratio	
Number of school days lost who returned to his or her occupation	1.0	0.78 (0.52, 1.18) 0.245	1.13 (0.63, 2.03) 0.673

* Associations were adjusted for the same sets of independent variables included in the models that used wealth as measured through a polychoric PCA asset index and that are presented in Tables 9 through 16.

Table 16. Literature on household socioeconomic consequences of and responses to injuries in rural regions of low and middle-income countries

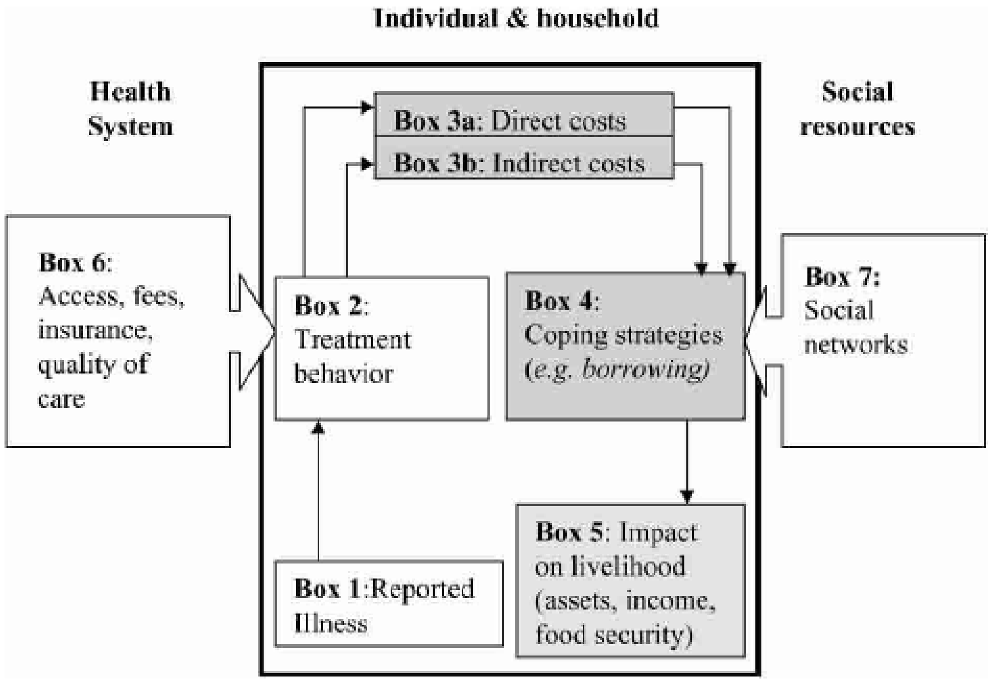
Study	Region	Cause of Injury	Socioeconomic Consequences
Joshi and Shrestha 2009	Urban Nepal	All causes	The cost of a single injury case, when cost is measured as medical expenses and lost work time, was 126 USD.
Juillard et al. 2010	Nigeria, seven states where 40% live in rural areas	Road traffic	• Average cost of formal treatment was 35 USD. • 6 out of 36 employed individuals lost their jobs. • 44% lost between one and seven days, 36% lost between one and four weeks, and 20% lost over a month of work • 31 out of 35 individuals reported a reduction in earnings as a result of disability
Mock et al. 2003	Ghana, four rural districts	Blunt, penetrating, or burn	• 3% of households reported a loss of income • 33% of households reported a decline in food consumption and • 28% of households reported a decline • No effect on household income or food consumption • The most commonly reported coping strategies were intra-family labor reallocation (90%), borrowing money (24%), and sold but did not pawn belongings (2.5%) • Intra-family labor reallocation was utilized by 93% of households located on unpaved roads and 83% of those on paved roads. the chi square test found this relationship significant.
Nguyen et al. 2012	Individuals admitted to Thai Binh General Hospital in Vietnam	All causes	• Average total (direct and indirect) cost of injury was 365 USD • 26% came from households that experienced catastrophic expenditure following an injury. • Risk of catastrophic expenditure was higher among those who had more severe injuries, were of older age, and had a lower income
Riewpaiboon et al. 2008	Patients of a community hospital in central Thailand	Road traffic	The average (direct and indirect) cost per case was 2,596 USD.

Figure 1. Financial and economic impacts of disease or injury on households (single period case)



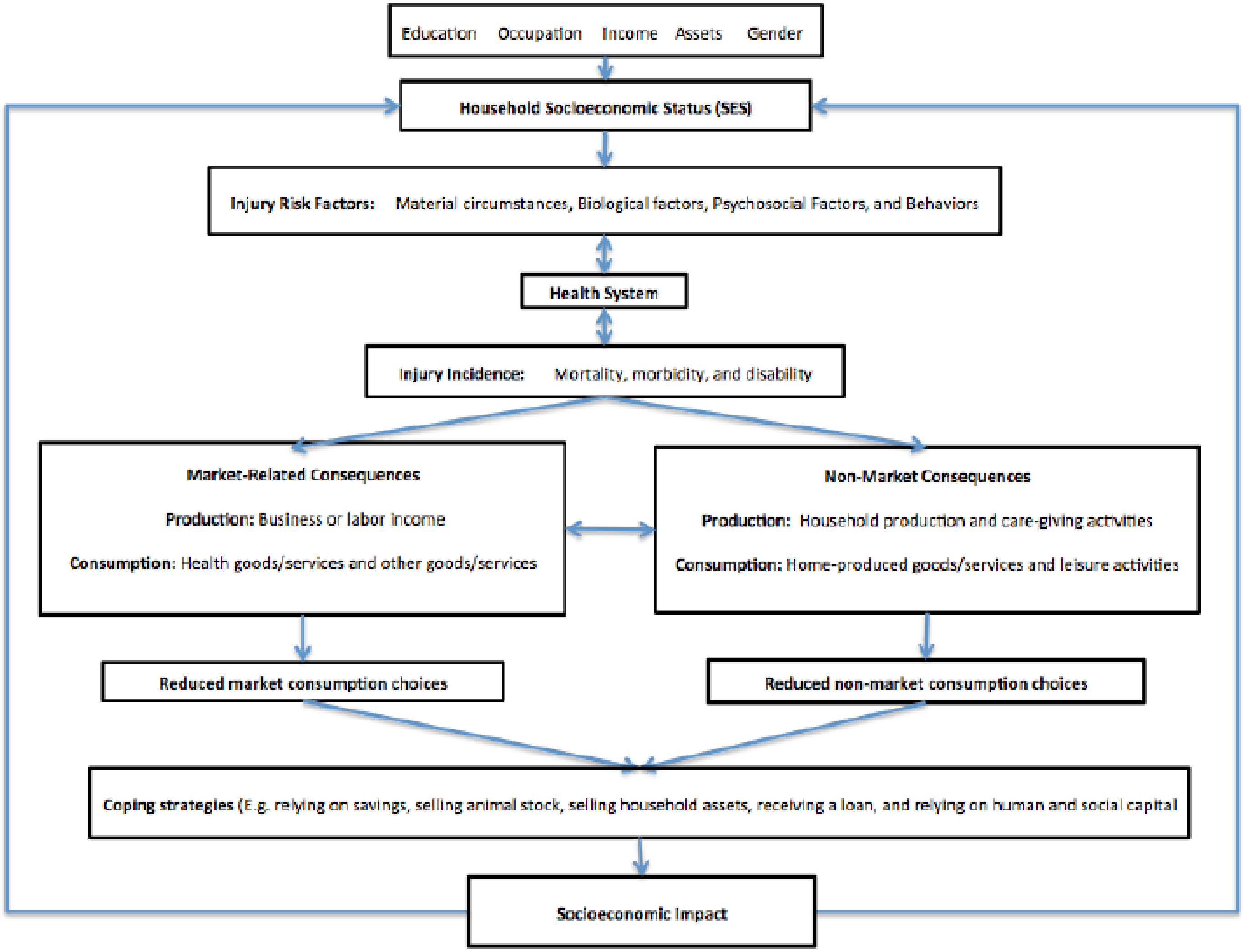
Source: WHO Guide to Identifying the Economic Consequences of Disease and Injury. Gevena, Switzerlind: Department of Health Systems Financing, Health Systems and Services, World Health Organization, 2009.

Figure 2. Conceptual framework for analyzing the economic burden of illness for households



Source: Russell S. The economic burden of illness for households in developing countries: a review of studies focusing on malaria, tuberculosis, and human immunodeficiency virus/acquired immunodeficiency syndrome. *Am J Trop Med Hyg* 2004; **71**(2 suppl): 147-5

Figure 3. Conceptual Framework For Research



Source: Author

Figure 4. Map of Uganda, showing the Iganga-Mayuge-Demographic Surveillance Site within the Iganga and Mayuge Districts

Figure 5. Frequency of asset index score by polychoric PCA in the rural IM-DSS (n=7,355)

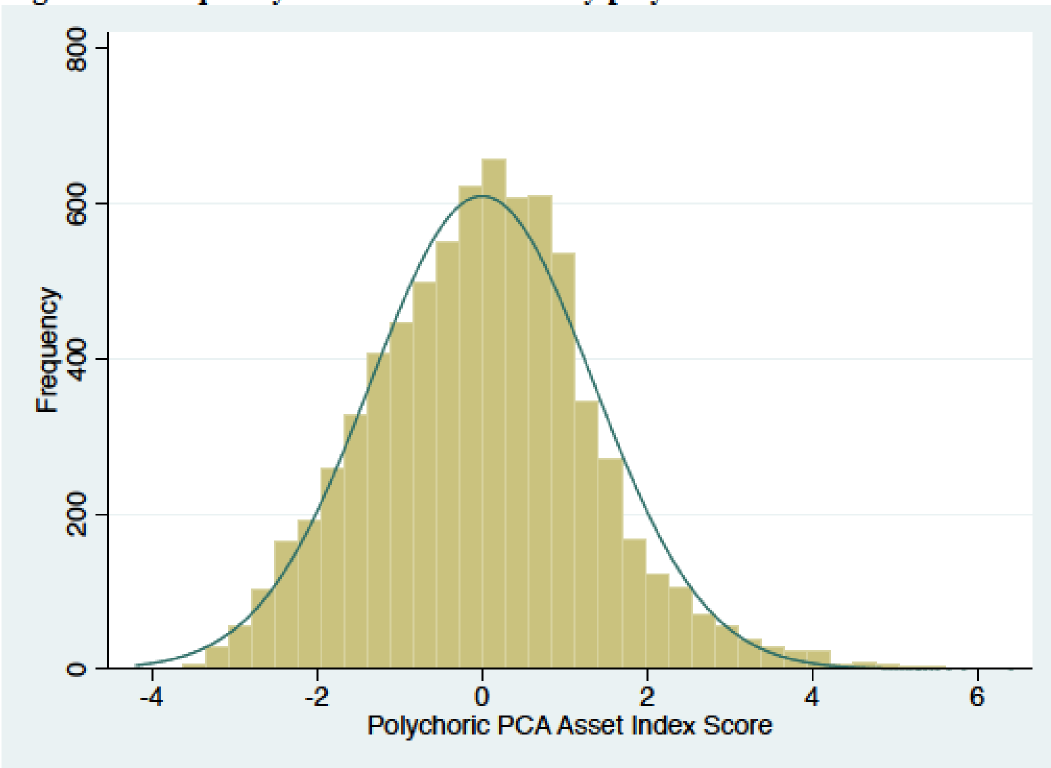


Figure 6. Percentage of variance explained by the firs four principal components of the polychoric PCA-based asset index

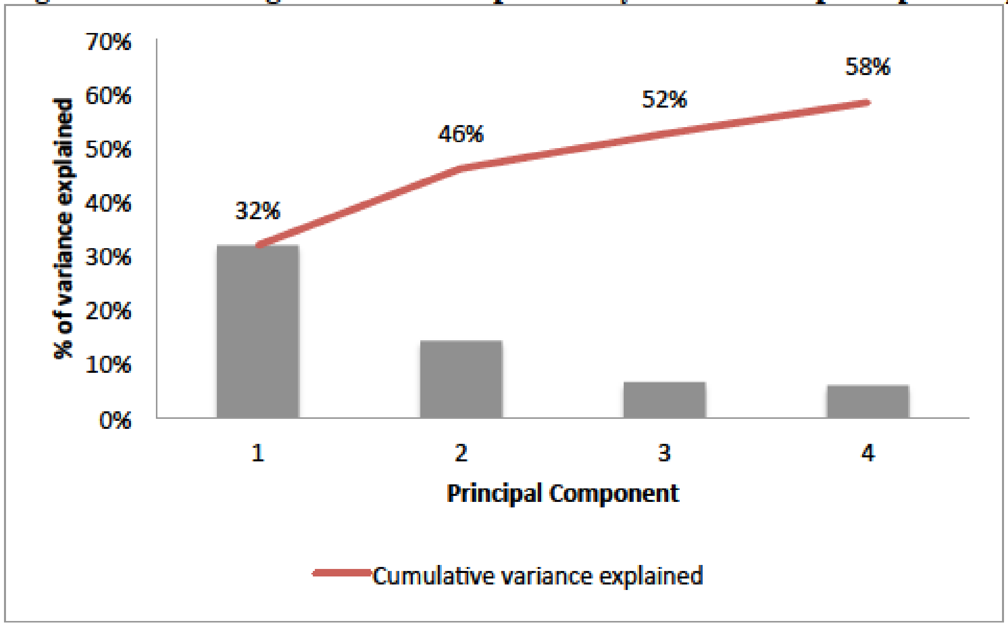


Figure 7. Percentage of variance explained by the firs four principal components of the Pearson correlation PCA-based asset index

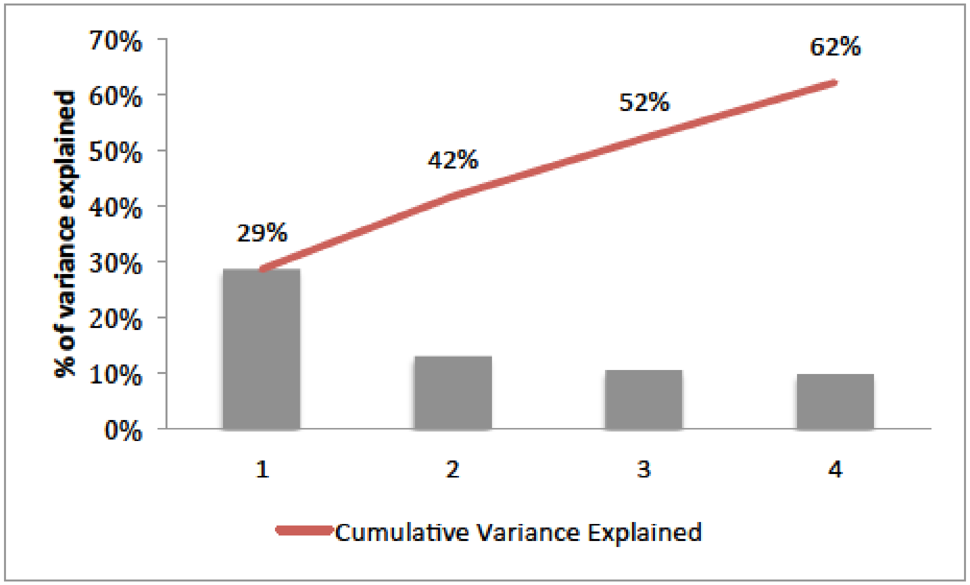


Figure 8. Frequency of simple sum of assets index score in the rural IM-DSS (n=7,355)

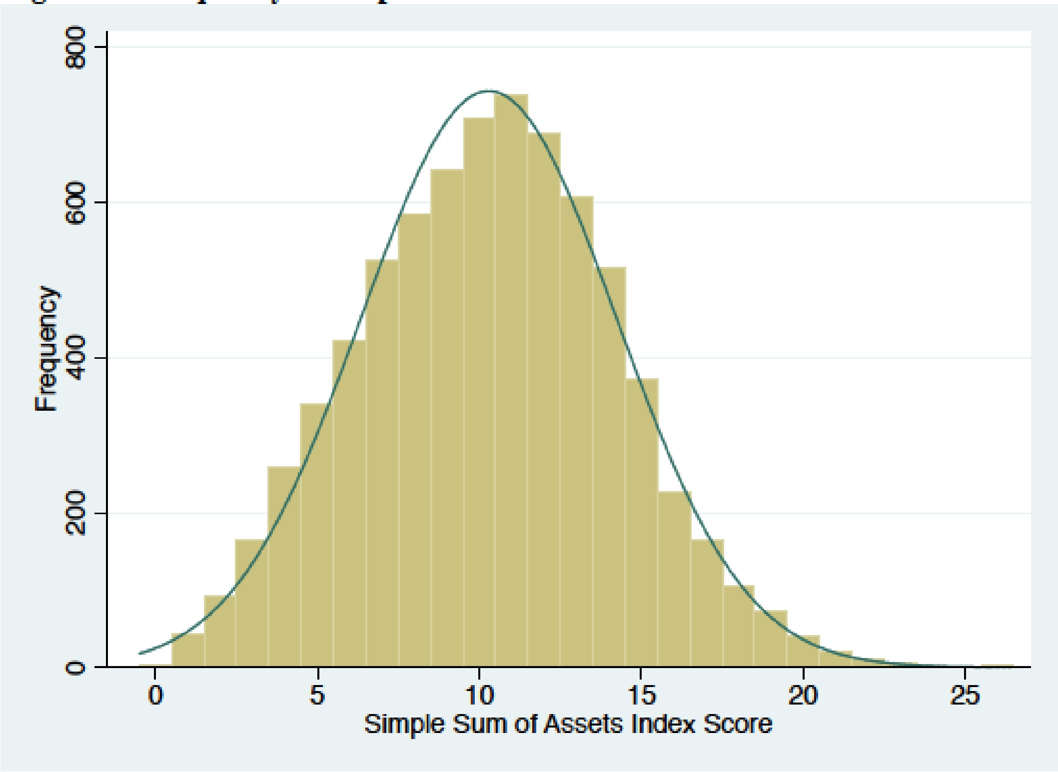
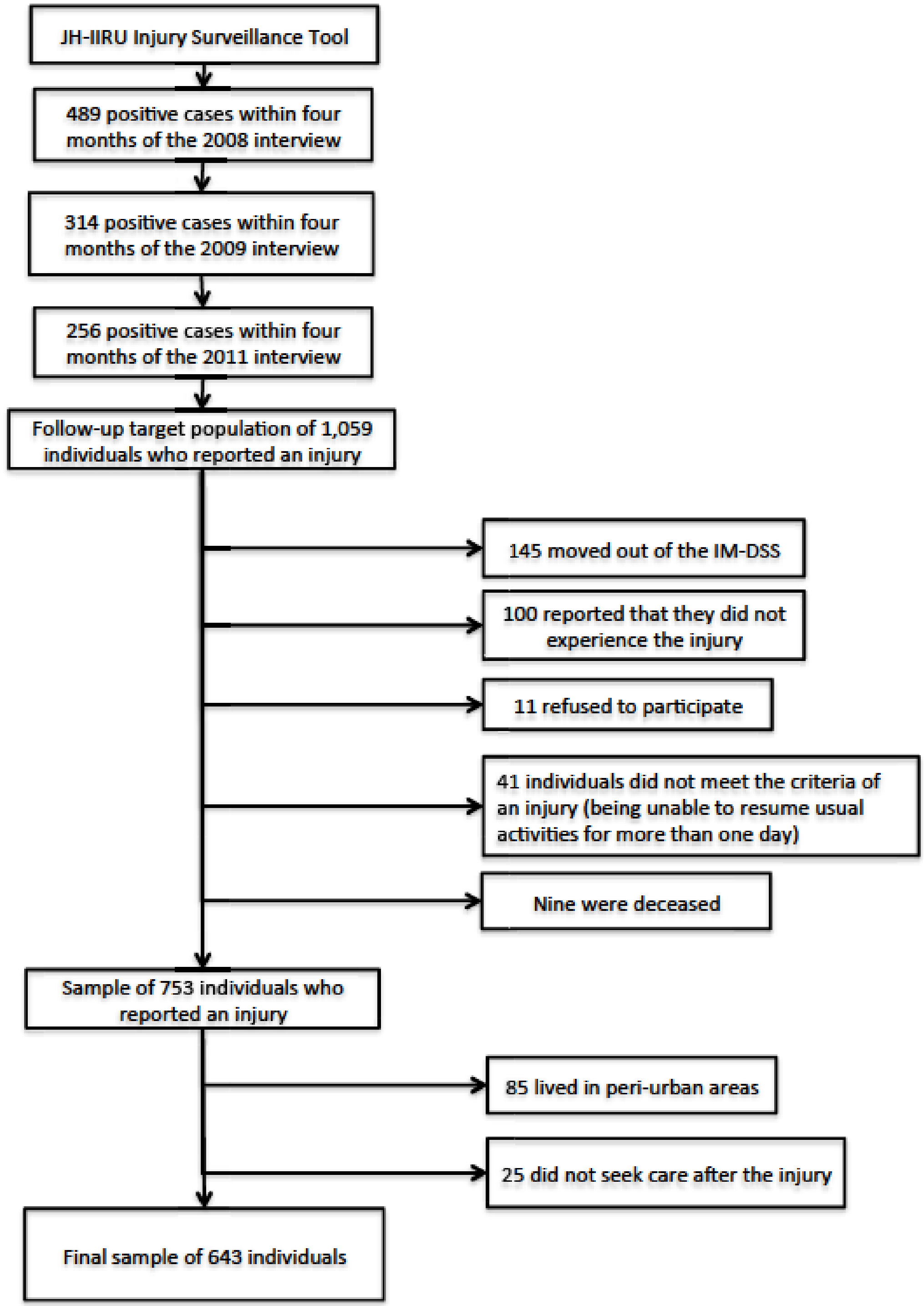


Figure 9. Study Flow Chart of Sample Selection



Paper Three:

Household Socioeconomic Consequences of Injuries in a Demographic Surveillance Site

Abstract

In 2013, injuries have led to the deaths of nearly 5 million people and the loss of 276 million disability-adjsuted life years (DALYs), but there is a great need to better understand their socioeconomic impact on the injured's household well-being in sub-Saharan African countries such as Uganda. To explore this research question in eastern rural Uganda, a cross-sectional study was conducted at the Iganga-Mayuge Demographic Surveillance Site (IM-DSS), a population-based site that tracks demographic events and monitors health among those living in the Iganga and Mayuge district. During three of the data collection rounds in 2009—2011, the Johns Hopkins University International Injury Research Unit (JH-IIRU) implemented a household-based injury surveillance tool that detected injuries that took places within four months of the interview. This cross-sectional study followed up on the individuals who reported an injury according to the surveillance tool and collected data on the individual's most recent injury through in-depth interviews. Among the 643 injured individuals living in the rural IM-DSS, males constituted 63% of the sample, nearly half of the sample had between five and 29 years of age, and 53% fell in the highest or second highest wealth quintile.

The three major household socioeconomic consequences were a decrease in income (85%), food production (59%), and food purchases (42%). In response to the injured individual's difficulty with resuming usual activities, the experience of receiving help was common to 87% of the injured's households. This help typically entailed the provision of necessity goods such as food or clothing, and the majority of the helpers were members from the same household. Respondents found that the coping strategies

that were most important to the household were unconditional help from family and friends, followed by relying on savings, and then selling animal stock.

Functional impairment significantly increased the likelihood of a decline in income, food production, and food purchasing, as well as receiving help due to difficulty with the injury. Cost of transportation to initial care and cost of care predicted a decline in household income, food production, and food purchasing, and belonging to poorer household groups significantly impacted the reporting of a decline in household income and food production. Wealth did not significantly influence the likelihood of receiving help nor did it predict the selection of the most important coping method. This study has highlighted the vulnerability and resiliency of households in the face of an injury, and all of these household negative consequences suggest that addressing the injury burden with preventative and curative interventions can yield social and economic returns.

Introduction

In 2013, intentional and unintentional injuries had led to the deaths of over 4.8 million people, accounting for nearly ten percent of global mortality.[1] Injuries contributed to 276 million disability-adjusted life years (DALYs), which was 11% of all DALYs lost around the world. A large injury burden lies in sub-Saharan Africa, where injuries contributed to over 7% of all DALYs lost in the region.[2] Between 1980 and 2010, road traffic injury (RTI) death rates increased by 29.8% in the southern region.[3] In western sub-Saharan Africa, this increase was 15.2%, and motorized road transport was the third leading cause of death and one of the top five risk factors for loss of DALYs in 2010.

In addition to the loss of mortality and morbidity following an injury, existing literature indicates that households with an injured member face a number of socioeconomic consequences. For example, a study conducted in rural Ghana found that among those who experienced an blunt, penetrating, or burn injury, 39% reported a loss of income, 33% reported a decline in food consumption and 28% report a decline in food production.[4] A population-based survey in Nigeria found that among those who experienced an RTI, 89% experienced a reduction in earnings.[4]

Furthermore, to determine how best to protect vulnerable households and mitigate such socioeconomic consequences, one must understand the coping actions of a household when faced with an injury. The concept that households employ coping strategies has been explored in the context of food scarcity and famine in South Asia decades ago,[5,6] and in that context, coping had been defined as a "short-term response to an immediate and inhabitual decline in access to food."[7] The term "coping" has also been applied to illnesses in sub-Saharan Africa,[8-10] particularly HIV/AIDS.[11-13] For example, household-level responses to an illness aim focused on the management and minimizations of "costs of an event or process that threatens the welfare of one or more members of the household."[11] Following an injury, households in Ghana re-allocated intra-family labor,[14] borrowed money, and sold belongings, but outside of that one study, household coping responses to an injury remain largely unexplored. These households also reported the employment of financial coping strategies such as intra-family labor allocation, money borrowing, and the selling of belongings.

Some gaps in the existing literature on household socioeconomic consequences merit attention. First, many of the studies were limited to one specific injury cause and to our knowledge, no studies on the socioeconomic consequences of all-causes injuries been conducted in Uganda. Second, while previous work has estimated the household economic burden of an injury, additional work must explore if these outcomes are associated with sociodemographic and injury-related characteristics. Finally, there is a dearth of research that provides a clear picture on a rural household's preferences for and assessment of coping mechanisms and strategies employed to mitigate the injury's household impact. Such research would make an important contribution to the field of injury prevention and treatment in countries such as Uganda as well as assist households in their goal to advance their social and economic well-being.

In order to advance the field of injury treatment and prevention in LMICs, more studies need to be conducted on these topics and relationships.

Conceptual framework

A conceptual framework was constructed to guide the design and analysis of this study, and it is based on three existing frameworks. First, to explain the patterning of disease and death, Link and Phelan developed the fundamental cause theory to highlight the dynamic process through which social conditions such as sex, ethnicity education, and income affect health. When effective interventions or preventative measures become available to a population, those who have greater access to wealth, power, prestige, and beneficial social networks confer the health advantage to protect or treat themselves. This framework thus compels one to examine how social conditions shape risk factors for illness and death. World Health Organization's Commission on Social Determinants of Health developed a similar framework to explain health equity, and this framework categorized risk factors into biological factors, behaviors, material conditions, and psychosocial factors.[15]

While the determinants of health are strongly sociological by nature, the distribution of health and well-being, in turn, influences social hierarchy. This process is captured by the second framework of interest to this study: the Financial and Economic Impacts of Disease or Injury on Households (Figure 1) by the *WHO Guide To Identifying the Economic Consequences of Disease and Injury*.[16] An ill health event can impede a household's ability to achieve the three utility objectives of maximizing leisure time, consumption of home-produced goods, and consumption of non-health market goods. The household may suffer losses in paid or unpaid production, increase consumption of services and goods related to the care required for the ill health event, decrease consumption of non-health goods and services such as food and clothing.

A third framework similarly explores the aftermath of an illness including its costs and financial impacts, but it also presents the decisions that households make to sustain economic viability (Figure 2).[11] The first three boxes of Russell's framework resembles the information presented in the framework described above (Figure 1), in that an illness leads to a number of direct and indirect costs. By providing a separate box for coping methods such as borrowing, this framework gives more weight to the selection and employment of coping strategies as a step in the process of how health impacts household livelihood.

Drawing from these three frameworks, this study will follow a framework describing the socioeconomic disparities of injury and the household socioeconomic consequences and coping strategies (Figure 3). Indicators of education, occupation, income or assets, and gender influence the latent construct of socioeconomic status, as shown at the top of the framework. Socioeconomic status can effect injury risk factors such as choosing not to wear a motorcycle helmet, having frail bone structure, working in an area that has poorly constructed roads, and feeling psychological stress on the day of the injury. The availability of quality health care also shapes incidence and outcome of an injury. Finally, an incident injury will lead to a combination of morbidity, disability, and/or death, an outcome that will depend on the individual's interaction with the health care system. The household with an injured member may suffer the various market and non-market related economic consequences, including a decline in paid and unpaid production, a decrease consumption of non-health goods and services and assets, and increases in health goods and services. In response to these adverse outcomes, a household will decide how to cope with the injury financially, such as selling assets or animal stock, relying on savings, or drawing from the existing social capital. All of these events ultimately contribute to an injury's socioeconomic impact on a household, which, in turn, feeds back into household socioeconomic status.

Goals and Objectives

The overall goal of this study is describe the changes in household socioeconomic outcomes occurring as a result of an injury experienced by one of its members.

The following specific objectives were developed to achieve the goal stated above: (1) to detect changes in post-injury household income, food production, and food consumption, (2) to determine how sociodemographic and injury characteristics predict changes in household income, food production, and food consumption, (3) to describe the extent to which households receive help for the injured individual's inability to resume usual activities, including type of help, relationship with the helper, and length of time help was received, (4) to identify which household financial coping strategies were most frequently used and which were considered to be most important, and (5) to determine how sociodemographic and injury characteristics predict selection of financial coping strategies which were considered most important.

Methods

Study design and data sources

This follow-up cross-sectional study utilizes data from a demographic surveillance system, which is a population-based site that tracks demographic events and monitors health in a geographically defined population over time.[17] The Iganga-Mayuge Demographic Surveillance Site (IM-DSS) was established in partnership with Makerere University in 2005 with the goal of generating information to support evidence-based decisions and policy making in the Iganga and Mayuge districts but also at a national level. The site is based in a predominantly rural region in eastern Uganda, about 120 km east of the capital Kampala (Figure 4).

In 2008, the Johns Hopkins University International Injury Research Unit (JH-IIRU) collaborated with the IM-DSS to explore innovative approaches to screen for disability and to characterize it through an in-depth disability and injury assessment module that was designed to be incorporated into regular IM-DSS data collection (Appendix 1).[18,19] The injury component of this survey asked the head of each household (or the senior most member of the household present at the time of the interview) if any member of the household had an injury in the last four months. Injuries were defined as that which prevented "the victim from carrying out his or her normal daily activities for at least one day or for which [the household] paid for any treatment." The four-month period was chosen because the IM-DSS collects data once every four months. The first data collection took place during February—April 2009, the second round took place during March—May 2010, and the third took place in January—February 2011.

The 1,059 individuals who reported an injury according to the parent survey described above form the target population for this study. Enrollment of subjects for this study began in August 2011, taking place outside of the regular IM-DSS rounds of data collection, and continued through October 2011. Field assistants followed up each subject through a visit to his or her household, requested study participation, and obtained consent before proceeding with the survey. In cases where the subject was not present in the household during hours of data collection or was under the age of 18 years, the head of the household provided responses on his or her behalf.

Household-based interviews began with the question of when was the subject's most recent injury. The field assistants explained injury was defined as something which prevents someone from carrying out normal daily activities for at least one day or something for which someone paid for any treatment, and then provided examples such as RTIs, violence-related injuries, poisoning, burns, animal bites, and unintentional falls. Then a structured survey collected information on that injury event. Information included the type of injury, risk factors and events leading to the injury, health care that was sought and received following the injury, and socioeconomic consequences of the injury (Appendix 2). Outcomes in the survey included changes in income, food production, and food purchases due to the injury, and various methods of coping with the injury financially. The survey questions were adapted from the World Health Organization (WHO) Guidelines for Conducting Community Surveys on Injuries and Violence and from the World Bank's Living Standards Measurement Study.[20,21] The survey instrument was translated into Lusoga using a standard translation-back-translation protocol,[22] and the translated instrument was pre-tested with local field workers to ensure accuracy of the translation process as well as the clarity of the questions. Interviews were conducted in the local language of Lusoga and all field assistants come from the Iganga and Mayuge communities.

In addition to the data collected from the survey, this study utilizes three datasets from IM-DSS. All survey instruments were consistent with other demographic surveillance sites which are part of the International Network of Field Sites with Continuous Demographic Evaluation of Populations and Their Health (INDEPTH) network.[23] First, the IM-DSS field team collects health and demographic data from all individuals in all households in the site every four months. The demographic information includes migrations, births, age, sex, deaths, and verbal autopsy (Table 1).

Second, the site has also collected household socioeconomic information during two rounds of data collection: October 2008—March 2009 and August—November 2011. These data include occupation of the household head, physical characteristics of the household such as the materials used for the roof and main source of water, and ownership of various household assets.

Third, this study uses a database developed by the IM-DSS to classify each of the 65 villages in the area as either rural or peri-urban based. All villages that formed the Iganga Town Council were considered peri-urban while the majority of villages fell into the rural category with some exceptions.

Sample

The study sample was determined by the distribution of two independent variables of interest. First, the injured individual's household wealth is measured through an asset index (further explained in the next section). Constructing an asset index for combined rural and urban regions can misclassify a household's quintile, particularly in situations where one asset may indicate greater wealth in one location but lesser wealth in another.[24,25] A stratified analysis that differentiates the sample by the village development, rural or peri-urban, would be the best approach to studying socioeconomic consequences and controlling for characteristics such as household wealth. But the peri-urban sample is too small to model for nominal or even dichotomous outcomes, so this study focuses specifically on the rural region of the IM-DSS. Second, a largely uneven distribution was observed for the variable on whether or not the individual sought care after the scene of the injury (further explained in the results section). In the interest of building models that include independent variables capturing the loss of money and time when seeking initial time care, this study included only those individuals who sought care after the injury.

Outcome variables

This study's major outcomes of interest are (1) loss of household income, (2) a decrease in household food production, (3) a decrease in household food purchases, (4) receipt of help for the injured individual's difficulty with the injury, (5) whether or not a specific financial coping mechanism was identified as being one of the top three most important methods in coping with the injury, and (5) which financial coping methods was considered to be the first most important strategy.

Independent variables

The independent variables include sociodemographic characteristic, including sex, age, household head occupation, and injury characteristics, including cause of injury, duration of time during which the injured was unable to resume usual activities, and time elapsed between the injury and the interview (Table 2).

To construct a wealth quintile variable and to handle the high-dimensional nature of the asset data from 7,355 rural households, a principal components analysis (PCA) was conducted.[26] In this analysis, each asset is a random vector of dimension p with a finite p x p variance-covariance matrix. Two kinds of variables were included in the PCA (Table

3): dichotomous variables, representing household ownership or non-ownership and taking on the values of either zero or one; and discrete and ordinal variables, such as main source of light. To handle the discrete and ordinal nature of information, covariances between variables were estimated using a polychoric correlation.[27] The PCA then identifies patterns in the information on assets, highlights similarities and differences, and reduces the high-dimensional data to orthogonal linear combinations of variables, a simpler dimension that captures the underlying construct. The linear combination of asset scores with the greatest amount of information common to all of the variables, represented by the largest variance of the projections of the vectors, is known as the first principal component. The percentage of variance in the asset items demonstrates the extent to which the variation in asset items between households can be explained by this one measure of SES.

The strength of the association of an item with this first principal component determines the weight of the items in the asset index, or the factor score. An important assumption for the model is that this first principal component represents the construct of household wealth.[26] The asset index score (A_j) for each household *j* is calculated as follows:

$$A_j = f_1 \times (a_{j1} - a_1) / (s_1) + \ldots. + f_N \times (a_{jN} - a_N) / (s_N)$$

where
f_1 = the "scoring factor" for the first asset as determined by the analysis
a_{j1} = the *j*th household's value for the first asset
a_1 = the mean of the first asset variable over all households
s_1 = the standard deviation of the first asset variable over all households

Then, looking at the frequency distribution of the asset index scores of the households, a distribution that is weighted in the same way that the items in the asset index are weighted, this study will rank households by their individual scores and create cutpoints to divide the distribution into quintiles, or five sections constituting 20% of the sample.

The selection of assets for the PCA began with gathering expert opinions from the Uganda-based investigators, as their local knowledge helped identify which variables do not perform well in differentiating the wealth of one household from that of another.[28] First, given the greater availability of land to a rural household, burning waste and disposing waste, particularly biodegradable waste, in the gardens is practiced by both affluent and less affluent homes. Second, the main source of drinking water and type of toilet used by the household often depends on the infrastructure available on a community level, so this variable was omitted in the interest of separating community from household wealth effects. Third, the dichotomous variable on land ownership was also described as being ambiguous, as it does not capture the quality of land. Similarly, information on household's type of dwelling tenure does not accurately portray the household's wealth. The majority of the 7,355 households constructed and own their dwellings (74%) while 12% rent from an individual. But attaching a monetary value to this type of asset ownership is complicated due to a weak housing sale and rental market and because construction of these houses often uses found materials and/or minimal material resources.[29,30] Data on the quality of the dwelling's materials such as those used for the roof, wall, and floor, are included in this analysis, but type of tenure is not.

Finally, data from a 2005 IM-DSS round reveal that out of 60,228 participants, 55% were Muslim, so owning a pig was omitted from the asset analysis.

Descriptive analyses also identified assets that should be excluded due to a large proportion of missing data. All of the variables on the quantity of a specific food, such as rice, maize, or millet, stored by the household at the time of the interview had missing data for more than three quarters of the rural households. Information on availability of shutters and on whether or not the household land or plot was enough to grow food to feed its members had missing data for more than 20% of the household sample, so this variable was removed from the analysis as well.

The estimation of covariances between the asset variables through a polychoric correlation brought attention to variables that cause missing correlation: ownership of a car, gas or electric cooker, a car, a truck, bus, or tractor, a landline phone or a bed. These binary variables have a very small group of ones or zeros, a quality that does not conform well to the polychoric assumption that two latent bivariate normally distributed random variables generate two observed ordinal scores.[27,31]

Using the final set of assets (Table 3), a raw total asset score was calculated for each of the 7,355 households. The 0.29 skew of this score variable and the appearance of the histogram in comparison to a normal distribution curve indicate a slightly positive skewness (Figure 5). The PCA reduces the dimensions of these asset data so that the first principal component represents household wealth. The proportion of variance explained by this first principal component can affect the index's risk of misclassifying a household in the wrong group, so this study aimed to build an index where the first component explained at least 30% of the variance. In this study, the first principal component based on the final set of asset variables accounted for 32% of the variance (Figure 6).

Two additional indices were created with the purpose of comparing different weighting methods and their impact on household classification results. First, selecting from the same set of variables used for polychoric PCA-based index, this study conducted the PCA method that was originally developed for the multivariate normal distribution using the Pearson's correlation matrix.[32] The resulting index, however, presented problems that warranted attention. Due to numerous weak coefficients displayed in the correlation matrix, extensive variable pruning was required to yield an index with a first component explaining 28.6% of the data (Figure 7). This final set excluded more than two-thirds of the total number of assets including in the polychoric PCA-based asset index, a very noticeable loss of rural household asset information (Table 3). Furthermore, the slightly positively skewed score distribution (Figure 8) appears uneven and reveals that large proportion of households have the same score. This clumping quality can impede one's ability to create even wealth quintiles and properly differentiate between households by wealth.[33] Due to these potential threats to being able to distinguish between the relative poorer and richer households, the Pearson correlation-based PCA asset index was not included in this analysis.

A second alternative approach to constructing an asset index is the simple sum of assets, and previous studies have used this straightforward method that computes a sum across binary asset variables and equal weight to asset regardless of its quality.[34-36] This index included all of the variables used for the polychoric PCA-based asset index (Table 3), but six categorical variables were recoded into binary ones. Expert opinions from the Uganda-based investigators were solicited to ensure that the dichotomy of theses variables was appropriate and meaningful (Table 4). The resulting sum of assets index score had a very low value of positive skewness (0.09) and a fairly even normal distribution.

Finally, the 7,355 households were classified into quintiles based on their asset index score built through polychoric PCA method as well the simple sum of assets method for the sake of comparison. For example, the first quintile consists of the poorest individuals whose score values comprise the lowest 20% of the index.

Missing data

A general consensus on what is considered a passable amount of missing data does not currently exist. In a review of education and psychology studies, the maximum proportion of missing cases was over 27%.[37] This study made the decision that a variable with data missing among over 20% of the households would pose a threat to statistical conclusions and generalizability. For a variable missing less than 20% of the sample's data, in response to the potential threat to making valid references, this study implemented multiple imputation, which has been shown to generate unbiased parameter estimates reflecting the uncertainty associated with estimating missing data and to perform adequately even in datasets with large amounts of missingness.[38-40] This method creates regression models for each variable to calculate and fills in missing information, and multiple rounds of this procedure results in a combined imputed data set that can be used for one overall analysis. This study employed the chained equation approach to multiple imputation, which assumes that missing data are missing at random and runs a series of regression models so that each variable with missing data is modeled according to its type of distribution (e.g. logistic or multinomial) conditional upon the other variables in the data.[41]

Analysis

To explore the financial coping mechanisms and characteristics of help received due to difficulty with the injury, descriptive analyses and frequency distributions were conducted.

Multivariable regression models were built to examine the effects of the sociodemographic and injury-related independent variables on the study outcomes of interest.

The outcomes of loss in income due to the injury, decline in household food production, decrease in food purchasing, and whether help was received for the injured individual's difficulty with resuming usual activities are all binary, so this analysis built logit models.[42] The observed outcome variable *y* was understood as capturing some information about a latent variable y^* that ranges from $-\infty$ to $+\infty$ and that is linearly related to the observed independent variables. This latent value represents an underlying propensity for the outcome and generates the observed y's. Respondents who have larger values of y^* are observed as y=1 while those with smaller values are observed as y=0. The estimation equation is as follows:

$$\text{Ln}\left[(\Pr(Y_{ij}=1)/(1-\Pr(Y_{ij}=1)\right]$$
$$= \text{Ln}\left[(\Pr(Y_{ij}=1)/(\Pr(Y_{ij}=0)\right] = \beta_0 + \beta_1 \text{x} + \beta_2\text{injury}$$

where
x_i is a vector of covariates
β_0 is the baseline value for observations with all covariates equal to zero

Maximum likelihood (ML) was used for model estimation under the assumption that the errors follow a logistic distribution. The coefficient values resulting from this estimation were transformed into the more interpretable odds ratio of the outcome.

The outcome for which financial coping method was reported to be most important has polytomous responses that do not have an ordered structure, so a multinomial logit models (MNLM) were built. [43] This extension of the logit model predicts a response (indexed as 1, 2, …J) that follows a multinomial distribution and detects the effect of covariates on the relationship between pairs of outcomes (e.g. 1 compared to J and 2 compared to J). Rather than estimating one logit through one equation, the model simultaneously estimates J-1 logits that respect the mathematical relationships between the parameters and use the available data efficiently. Letting the probability p_{ij} that the response of individual i, the i^{th} response, falls in the j^{th} category, then

$p_{ij} = Pr(Y_i = j)$

For example, p_{i3} may indicate the probability that the i^{th} respondent identified experiencing a fall injury. The injury type response categories were exclusive and exhaustive, so the probabilities add up to one for each individual. The model assumes that this probability is a function of a linear combination of a covariates X and the accompanying coefficients on outcome Y. The coefficients will differ for each outcome Y; for example, the coefficient of sex of household head on the probability of an RTI is different from the coefficient for sex of household head on the probability of experiencing an injury in the "other" cause category.

After nominating one of the response categories as a reference group (e.g. pedestrian, indexed as J), the model can predict the log odds of each category relative to baseline as a function of the vector of covariates. This linear model is specified as follows for j = 1, 2, 3, …J-1:

$$\begin{aligned}&\text{logit}(h_{ij})\\&= \log\left([p_{ij}/(1- p_{ij})] \div [p_{iJ}/(1- p_{iJ})\right)\\&= \alpha_j + x_i\beta_j\end{aligned}$$

where
α_j is a constant
x_i is a vector of covariates
β_j is a vector of regression coefficients

Two features of this model are important to note. First, no contrasts between categories went missing, as the contrast between j categories 1 and 2 were obtained by subtracting the log odds ratio for the outcome with a value of 2 (where value J is the reference group) from the log odds ratio for the outcome with a value of 1 (where value J is the reference group). Second, the model allowed for the calculation of predicted probabilities of each outcome response given a specific value for one variable while holding all other variables in the model at their means and the calculation of discrete changes in probabilities when one value of an independent dummy variable changes to another value.

Results

A total of 1,059 individuals were in the target population because they reported experiencing an injury according to the JHU-IIRU injury assessment module (Figure 9). During follow-up, it was found that 145 had moved to another household outside of the IM-DSS, 100 reported not experiencing the injury that was previously reported, 11 refused to participate, and nine were deceased. This study found that 41 individuals did not fit the criteria of experiencing an injury because they were able to resume usual activities within the first day, so this group was excluded from the study, leaving a total of 749 individuals. Of these individuals, only 85 (11%) live in peri-urban areas, and chi square tests comparing some sample characteristics reveal significant differences by sex, the injured's occupation, and the household head's occupation (Table 5). Among the 668 individuals living in the rural IM-DSS sample, the data again displays a largely uneven distribution where 643 individuals sought care after the scene of the injury, 25 did not do so, thus bringing the final sample to 643 individuals.

Males constituted a greater percentage of the sample (63%) than did females, and 48% were between the ages of 5 and 29 years (Table 6). At the time of the injury, nearly one-fourth of the sample held an occupation in farming or agriculture, but a large percentage was not earning an income. For example, 37% were students (37%) and nine percent were pre-school children, and this corresponds well with the observation that over half of the sample relates to the household head as his or her child or grandchild.

More than 46% of the injured came from households where the household head occupation was in farming or agriculture while nearly 15% came from households led by a laborer, and over 82% of the injured's households were led by a male. More than half of the injured lived in households that fell in the highest or second highest wealth quintiles, while 17.6% fell in the second lowest wealth group and only 12.5% fell in the lowest. More than half of the sample lived in households that fell in the highest and second highest wealth quintile groups while 12.5% were in the lowest wealth group and 17.6% were in the second lowest group.

Leading causes of injuries were RTIs (44%), unintentional falls (28%) and burns (10%) (Table 7). The amount of time between the interview and the subject's most recent injury varied, as 41% experienced the injury within 12 months of the date of the interview while slightly more than half reported that the injury occurred 18 to 36 months prior to the interview. When asked about functional impairment following the injury, 53% reported being able to resume usual activities after one and four weeks had passed, and 24% spent more than one month functionally impaired.

Among the 643 individuals who sought care after the scene of the injury, the most common modes of transportation to the site were by motorcycle (40%) and by bicycle (34%) (Table 8). The majority was able to reach the site of first time care without spending money (63%) and 22% spent less than one USD. The most common sources of first time injury care were hospital (36%) and private clinics (35%). Paying more than seven dollars for care was the most common experience (29%) while less than a quarter spent between two and seven dollars. Total direct costs associated with first time care, calculated as the sum of costs for transportation to first time care and costs of care services, ranged between one and five USD for 38% of the sample and between five and ten USD for 17%.

Household socioeconomic outcomes

A majority of study subjects (85%) reported experiencing a decrease in household income as a result of the injury (Table 9). The least commonly experienced household outcome was a decrease in food purchases, which was experienced by 42% of the sample. When restricting the sample to the 62 individuals who belonged to households where food was mainly acquired through purchasing, 48% reported a decrease in food purchasing after the injury. Over 59% of the rural IM-DSS sample reported a decrease in food production due to the injury, but among those belonging to households that mostly consume household-grown food, the percentage that experienced this consequence was 64%.

Income

Univariate models found that the odds of reporting a decrease in household income due to the injury significantly increased by a number of factors including being male, having between 15 and 30 years of age, belonging to a household in the middle wealth quintile as measured through a PCA-based asset index, being unable to resume usual activities for more than six days, and spending money on initial care (Table 10). In the first multivariable model controlling for all other variables including wealth as measured through a PCA-based asset index, a few of these relationships remained significant. In contrast to those belonging to households in the highest wealth quintile, those in the middle quintiles had 3.5 times the odds of income loss (95% CI, 1.24, 9.62). However, the multivariable model that includes wealth as measured through a simple sum of assets did not find any significant relationship between wealth and income loss. Compared to those who were able to recover in less than six days, the odds of household income loss were higher among those who needed one week or more (OR, 3.86, 95% CI, 2.29, 6.5). A dose response-like trend appeared in the relationship between household income loss and total costs associated with first time care, and both odds ratios for spending two to four dollars or more than four dollars were statistically significant.

Food purchases

The results of simple logistic regression models found that injured individuals in rural villages had a greater likelihood of reporting a decrease in food purchases if they possessed a number of characteristics such as having between the ages of 30 and 44, being bodaboda drivers or vendors, laborers, construction workers or mechanical workers, experienced an RTI, required more than six days to resume usual activities, having experienced the injury within 24 to 36 months of the interview, and spent more than one dollar on first time care transportation and services (Table 11). When adjusting for all covariates, the odds for reporting a decrease in household food purchasing were significantly greater only among those who spent money on first time care that ranged from two to four dollars (OR 2.39, 95% CI, 1.33, 4.28) or more than four dollars (OR 4.07, 95% CI, 2.61, 6.22). The second multivariable model including wealth as measured through a simple sum of assets led to the same findings on significance, but the magnitude of the odds ratios by cost of care was slightly larger.

Food production

The unadjusted odds of reporting a decrease in household food production were significantly higher among injured individuals who were over the age of 45 years compared to under five years or were farmers (Table 12). Unadjusted odds were also significantly higher among those in the lowest wealth quintile compared to those in the highest, and being unable to resume usual activities for more than six days, compared to less one to six days, yielded an unadjusted odds ratio of 4.3. Compared to those spent less than two dollars on first time care, those who spent a larger amount of money had significnatly greater odds of a decline in household food production.

In the multivariable model adjusting for all covariates including PCA-based household wealth, three variables emerged as having a significant association. Those coming from the poorest household had 2.4 times the odds of decreased food production compared to the wealthiest. Needing more than six days to recover from the injury, rather than resuming usual activities within six days, led to an odds ratio of 3.0 (95% CI, 1.87, 4.66). Individual who spent more than two to four dollars or more than four dollars on first time care and transportation to care had 2.2 and 4.1 times the odds of decreased household food production than those who had not spent any money. In the multivariable model that uses a simple sum of assets-based measurement of wealth, belonging to the poorest group of households also has a significant odds ratio but the magnitude is even larger (OR, 3.3; 95% CI, 1.87, 4.66).

Focusing on the 454 individuals who came from households that reported that their main source of food was household-grown food (Table 13), multivariable logistic regression Model 1 and Model 2 found that the set of significant predictors is the same as that found in the entire sample of 640 individuals and the magnitude was very similar. But in addition to the poorest group being at risk of a decline in food production, those in the second lowest quintile, as measured by a PCA-based asset index, were also vulnerable (OR, 2.03; 95% CI, 1.07, 3.87).

Household coping strategies

<u>Receiving help</u>

As one way to cope with the injured individual's condition following the injury, a majority (90%) of the sample received help from others (Table 14). The most common type of help received was necessities such as food, soap and clothing (75%), followed by services such as house help or child care (15%). Most of the helpers came from within the same household as the injured individual (90%), payment was hardly ever required (0.9%) and nearly half of those who provided help related to the injured individual were parents or parents-in-law, while one quarter were spouses and 11% were offspring. Nearly 27% of those who received help accepted the assistance for a total of one to six months while 29% were receiving help over two to four weeks.

Most injured individuals who were under the age of 15 years received help from their parents or parents-in-law and 62% of injured individuals between 30 and 45 years of age received help from their spouse (Table 15). Receiving help from someone in the "other" category, the majority of which were children, was the most common experience among those between ages 45 and 60 (45%) and those over 60 years (64%). Among the injured heads of households, 77% of the males received help from their spouses while 86% of female household heads received help from people in the "other" category, more than half of which were daughters or sons. Among injured wives of household heads who received help, the majority of the helpers were split between their daughters or sons of the injured (42%) and their husbands (41%).

Univariate logistic regression models that include PCA-based wealth found that the odds of receiving of help with the injured individual's difficulty with resuming usual activities significantly increased if the individual had less than 30 years of age, did not earn an income, experiencing an injury six to 12 months prior to the interview, and being unable to resume usual activities for one to four weeks (Table 16). Controlling for all variables in Model 1, the relationship between receiving help and the injured's occupation remained significant across all occupations, and being a bodaboda driver had a particularly strong protective effect (OR 3.0, 95% CI, 1.17, 7.45). The odds ratio for being unable to resume usual activities more than six days, as opposed to one to six days, after an injury also remained significant (OR 3.57, 95% CI, 1.86, 6.85). The relationship between wealth, whether measured through a PCA-based or simple sum-based asset index, and receiving help was not significant.

Most important financial coping strategies

When describing the most important ways in which the household coped with the injury financially, 46% of the households employed total of two financial coping strategy while over 40% employed only one coping strategy (Table 17). More than three quarters of the sample reported that receiving unconditional help from relatives and friends was one of the three most important coping methods, and 52% reported that relying on savings was one of the three most important coping methods. When ranking the importance of the method, 61% identified unconditional help as the first most important while 25% identified reliance on savings.

In the multinomial logit model that includes a PCA-based measure of wealth, four factors significantly affected the relative risk ratio of identifying unconditional help as the most important coping method relative to relying on savings: having over 15 years of age, having a household head who is a farmer, recall periods of more than twelve months, and spending more than six days in functional impairment (Table 18). The model adjusting for wealth measured by a simple sum of assets lead to the same set of significant predictors (Table 19).

The model can also be understood through marginal effects for each selection of most important coping method, and the two choices of savings and unconditional help are of particular interest (Table 20). According to the first model that uses wealth measured through a PCA-based asset index, two characteristics had a significant effect on the predicted probabilities of both options. All age groups over the age of 15 years increased the probability of selecting savings as the most important method but decreased the probability of selecting unconditional help. Having a household head who was a farmer, in contrast to having one who was a professional or worked in a shop or business, significantly decreased the probability of selecting savings as the most important method by 14 percentage points (95% CI, -0.249, -0.036) but increased the probability of selecting unconditional help by 10.8 percentage points (95% CI, 0.008, 0.209). Longer periods of time between the injury and the interview led to higher probabilities of identifying unconditional help as being the most important coping strategy, and needing more than six days to resume usual activities decreased the probability of identifying savings as the most important strategy by 11.4 percentage points (95% CI, -0.201, -0.027).

Discussion

This follow-up study identifies and describes a host of negative effects of injury on rural household socioeconomic well-being and ways in which households respond adversity. In order of increasing frequency, the three major socioeconomic consequences, were a decrease in food purchases, a decline in food production, and a decrease in income, all of which are consistent with other studies (Table 21).[14,44] The ranking of these outcomes by occurrence mirrors that which was observed in four rural districts of Ghana, but this study found that each of the three outcomes was experienced by even larger percentages of the sample in Uganda.

In response to the injured individual's difficulty with resuming usual activities, the experience of receiving help was common to 87% of the injured's households. Similarly, Mock et al. found that 90% of injured individuals in rural Ghana received help from another family member as a coping strategy, through specifically through intra-family labor allocation (Table 21).[14] In this study, more than half of the sample received help for a time period ranging from two weeks to six months, the most common type of assistance entailed the provision of necessity goods such as food or clothing, and the majority of the helpers were members from the same household. These findings indicate a cost of time, labor, and resources by other household members, broadening the range of indirect costs faced by a household when one of its members experiences an injury. The importance of time, output, and income lost by caregivers has been emphasized by previous studies measuring the household economic costs of other diseases,[8,45] and this study adds to the evidence, spotlighting injures in a rural sub-Saharan African context.

In identifying which coping strategies were most important to the household, respondents most frequently cited unconditional help from family and friends, followed by relying on savings, and then selling animal stock. In a number of sub-Saharan African countries, it has been found that to cope with medical bills, most households reported the borrowing or selling assets,[46] but less than nine percent of respondents in the rural IM-DSS felt that selling assets was important, a finding that resembles Mock's result that only 2.5% of families with an injured member sold belongings in rural Ghana. When asked to identify the most important coping strategy, the top two responses were receiving unconditional help from family and friends and relying on savings. This finding, along with the finding that the majority of helpers lived in the same household, reveals that most households draw from their own resources, time and labor to cope with an injury financially.

Predictors of household socioeconomic consequences and coping strategies

A number of important variables have emerged as significant predictors of negative household consequences. First, for the outcomes of a decline in income, food production, and food purchasing, as well as receiving help due to difficulty with the injury, the impact of functional impairment is evident, and expected given its relationship with productivity . In Nigeria, individuals who were disabled due to an RTI similarly reported a reduction in earnings (Table 21).[4] When facing functional impairment for a period of a week of time, households had a significantly decreased probability of stating that using savings was the most important coping strategy.

The association between disability and socioeconomic status has been explored in previous research, and while those studies did not confine the measurement of disability to that resulting from an injury, nor do they provide any temporal causality, the connection of this study to those findings is worthwhile. Indeed, in urban areas of Uganda, consumption-based household poverty was higher among households headed by a disabled person than among their non-disabled counterparts.[47] In South Africa, the percentage of households reporting the experience of hunger by any member of a household was higher among disabled household heads than non-disabled ones.[48]

The prominent role that functional impairment plays in household socioeconomic well-being in the IM-DSS supports the capability approach in economic theory where the focus is on a person's basic capability to function.[49] According to Sen, a dignified quality of life is defined not by inputs and asset ownership but rather outputs and "being and doing," such as ensuring nourishment and shelter.[49] And while this study examined functional impairment as a predictor of household socioeconomic status, Sen's framework would also suggest that the individual's capability itself is a measure of welfare or standard of living, and that the result of a disability following an injury is an impoverishment of its own.

Second, this study also highlights the importance of health care expenditures on injuries, as the cost associated with first time care predicted a decline in household income, food production, and food purchasing, and this includes dose response-like relationship with loss in income and food production. While this study does not prove that payment for care is a causal factor for these outcomes, it reveals that injuries led to a combination of direct and indirect consequences. These findings, particularly the association between first time injury care expenditures and the reported decrease in food purchasing, raises the question of whether or not injury care costs threatens a household's financial stability and food purchasing power in the IM-DSS. Future work must help understand the impact of health expenditures on household well-being, explore the potential of health impoverishment and the medical poverty trap[11,50] by measuring the total costs of injury, including care received after the first time, the timing of payment (e.g. paid in full or over time), and how these direct costs relate to household resources present before the injury (e.g. costs as a percentage of household income).

Third, household wealth, as measured through an asset index, significantly impacted the reporting of a decline in household income and food production. Individuals in the middle quintile were more at risk of reporting a decrease in income, but the approach to building the asset index made a difference, as the relationship was only significant for the PCA model. The Mock et al. injury study measured wealth as the degree of household location remoteness based on transportation access of the village and studied the variable's relationship with economic consequences. [14] This very different approach to SES measurement likely contributes to their contrasting conclusion that their four categories of SES did not predict a decline in household income. Compared to the highest quintile, those in the poorest were more at risk of experiencing a decrease in food production, and the model with the simple sum of assets-based measure of wealth found that the second poorest also had significantly greater odds. The magnitude of these associations was even greater when the analysis focused only on those who belonged to households where the main source of food was household-grown.

Wealth notably did not predict the likelihood of receiving help for the injured's difficulty with resuming usual activities nor did it significantly influence the choice of the most important copign method. This again differs from Mock's finding that households of lower socioeconomic status (categorized due to their living on unpaved roads), were more likely to employ intra-family labor reallocation than were their counterparts of higher status (Table 21).

Fourth, the difference between children under 15 years and all other older age groups is noteworthy. In comparison to injured individuals under the age of 15, individuals from all other age groups had a significantly increased probability of identifying that savings was the most important household coping method. These associations likely exist because those in older age groups contribute to household income and productivity, and when such a member becomes injured, the need for additional money becomes urgent. Having an injured child in one's household, in contrast to all other age groups, also significantly increased the likelihood of finding that unconditional help was the most important strategy, perhaps indicating the time, supervision and resources required to care for an injured dependent.

Fifth, having an occupation in agriculture or farming unsurprisingly puts the injured's household at greater risk for a decline in household food production due to the injury. The debilitating impact that HIV/AIDS has had on rural livelihoods and farming in sub-Saharan Africa, including loss of income and a diminished capacity for food production, has been well captured in previous studies,[51,52] and this finding suggests that injuries have a similar influence on farm households and warrant attention.

Finally, while length of recall time was a concern in this study which included a wide spectrum of months passed since the most recent injury, the variable did not significantly affect any of the household socioeconomic outcomes. One exception was that in comparison to those whose injuries took place within six months of the interview. those who had recall periods ranging from place 12 to 36 months had a higher probability of selecting unconditional help as the most important coping strategy. However, there may be one benefit one benefit to studying this perception among those with a very long recall period. One may argue that these respondents have greater hindsight and ability to reflect on their long-term welfare and well-being and compare and assess the success of their coping strategies following an injury.

Limitations and strengths

The findings from this study are subject to limitations in measurement and study design. Measurement of the outcome variables in this study, including a decrease in household income, food production, food purchases, rely on the respondents' self-report and recall accuracy given the retrospective nature of the data collected. In one study in Ghana, it has been argued that to recall information on more severe injuries, the appropriate time period is 12 months.[53] In our study, differences in injury characteristics such as time required to restore functional status between groups of varying recall time periods were analyzed and found not to be significant. Further research is needed to identify determinants of memory decay and appropriate time periods for recall on injuries in sub-Saharan Africa. Another concern with outcome measurement in this study is that the causal relationship between injuries and household socioeconomic consequences remains unsettled given the cross-sectional follow-up study design and the absence of a control group. Despite these concerns about self-reported measures, one study design feature provides an important benefit to the validity of these findings: the follow-up survey. The definition of an injury may be vague or difficult for a field assistant to explain to a respondent, but all study participants had previously reported an injury through a surveillance tool and were able to validate their injury status through their interviews.

Selection bias is another issue of concern, as two groups of injured individuals are not represented in this study. Study criteria did not intentionally exclude those who died as a result of an injury, but this follow-up sample does represent any fatal injuries. By not studying these households that lose a member to an injury, especially those that lose a member of working age and likely suffer more serious socioeconomic consequences, the results are vulnerable to a survivor bias towards the null. Help received and other household financial coping methods may likely also differ following a fatal injury. Second, individuals who did not seek care after the scene of the injury were omitted from the analysis because they constituted a very small percentage of the sample. The decision not to seek care could be related to experiencing a minor injury, but it can also be related to not being able to pay for care, and this study was unable to explore outcomes among this particular group of people.

The independent variable for household wealth may be limited by the fact that it is constructed through the asset index, as ownership of an asset does not always capture the quality of the asset.[26] Still, the measure of assets has been shown to have the advantage of being more reflective of long-run household wealth and to have a high predictive value in estimating the relationship between SES and outcomes such as educational enrollments and malaria prevalence.[26,54] Another important household characteristic that is related to wealth is household education, but due to a large proportion of missing data, this variable was not included in the analysis.

Finally, this study is restricted to two eastern districts of Uganda, so findings on household consequences and coping methods may not be generalizable to other areas of the country. However, given the dearth of information on injuries and socioeconomic consequences in rural areas of Uganda and other sub-Saharan African countries, the focus on a rural population is valuable. This in-depth study also provides a more comprehensive picture of the socioeconomic effects of injuries by examining injuries of all causes and a range of direct consequences related to time, money, productivity, and educational investment

Policy Implications

This study will yields new information for the purpose of aiding in the development of public health policies, programs, and interventions to meet the needs of individuals at risk of injuries. First, although policy makers have recognized the importance of addressing injuries in Uganda,[55] there remains substantial unmet need. These findings demonstrate that households undergo serious socioeconomic consequences due to one of its members experiencing an injury and suggest that addressing the injury burden with preventative and curative interventions can yield social and economic returns.

Second, the positive relationship between all negative household consequences and length of time spent in disability, as well as the overwhelmingly common experience of needing help with the injured's difficulty with resuming usual activities, calls for more effective strategies for treatment and rehabilitation. One strategy of particular interest is community-based rehabilitation (CBR) because it operates within community development and is implemented through joint efforts of people with disabilities themselves, families, organizations, and relevant government and non-governmental staekholders.[56] A six-year project that aimed to provide medical rehabilitation to children with locomotor impairments in Uganda evaluated its successes and identified a number of components that would be necessary for appropriate recovery and rehabilitation. This study recommends that policy makers follow this "recipe for success" which includes CBR, physiotherapy, access to orthopedic surgery, rehabilitation centers or hostels, orthopedic appliance workshops, and a transportation system such as a dedicated vehicle for transporting patients to and from referral centers.[57]

Third, the associations between out-of-pocket costs associated with first time care and household well-being supports the argument for financial protection of the injured such as an increasing in the quality and quantity of public provision and subsidizing travel costs. High out-of-pocket expenditures in rural Uganda must take high priority in health and policy planning as pro-poor financing mechanisms should be explored, implemented and evaluated. Examples include micro insurance schemes targeting the poor,[58] vouchers,[59,60] and subsidies to enable the private sector to ensure fair and affordable pricing. Policy makers at the national level must also learn from the insurance reforms in countries such as Rwanda and Ghana and consider the adoption of a national health insurance scheme that is specifically pro-poor.[61-63]

Fourth, the evidence from this study calls for action on how best to protect farmers and the poorest households with an injured member from a decrease in food production. While the joint crisis of HIV/AIDS and food insecurity in sub-Saharan Africa was distinct, widespread, and extreme, given the disease's mode of transmission and its age and sex distribution,[52] some of the HIV/AIDS and food crisis policy recommendations proposed by de Waal and Tumushabe are insightful and applicable to injuries and the consequence of decreased household food production.[64] Specifically, this study also calls for a farming education and training program that covers the expected topics of improving food production and farm techniques but also integrates injury prevention and education. To protect one's household from the negative impacts of a health event such as an injury, the program would promote greater flexibility in sex- and age-specific labor roles, non-labor intensive crops, and systems that decrease vulnerability to ecological factors (e.g. genetic resources for drought resistance).

Fifth, the findings on coping strategies identify preferences and, more importantly, the resiliency and strengths of rural IM-DSS households in the face of injuries. Relying on savings was a popular strategy that was perceived to be effective, especially when the injured individual was older than the age of 15 years, so this paper calls for greater efforts to facilitate the mobilization of savings in rural Uganda. Microfinance services can help extend these financial services to marginalized populations, and one example is a program that increased savings and improved attitudes toward saving among AIDS-orphaned adolescents in Rakai, Uganda.[65] In studying household savings behavior, specifically the acquisition of deposit instruments, Kiiza and Pederson argue that formal financial institutions should play a key role in mobilizing savings.[66] This study thus calls for the government to work with these institutions and provide incentives to increase, improve, and bring their services to rural households and provide education and training on savings.

Future Research

This paper also gives impetus for future research about indirect household socioeconomic consequences of injuries and the strategies employed to cope with injuries financially. First, to build on this study and explore the causal effect of an injury on household socioeconomic outcomes, a longitudinal study with a group of non-injured persons presenting counterfactual levels of characteristics that may influence the likelihood of becoming injured would be preferable. This design would help identify the channels through which injury leads to the household outcome and provide a more in-depth understanding of household coping strategies. Further work on coping methods should track how they change over time, examine the extent to which the strategies help households smooth consumption, stabilize and recover from direct and indirect injury costs, and identify ways in which these strategies may increase vulnerability to future adverse events or endanger long term household livelihood objectives.

Second, this study has revealed the importance of the cost of first time care, but more work must be done to understand the full impact of health expenditures on household well-being, to explore the potential of health impoverishment and the medical poverty trap,[11,50] and to examine the extent to which consequences vary between households of differing wealth. Future work should thus capture total costs of care, timing of payment (e.g. paid in full or over time), and how these direct costs relate to household resources present before the injury (e.g. costs as a percentage of household income).

Third, the finding that the majority of the households in this study found that the most important coping strategies involved intrahousehold reallocation of resources, specifically reliance on savings or receiving unconditional help from another household member, should spark further interest in the reasoning behind these preferred responses to an injury. By understanding the full range of options and resources available for a household looking to respond to the financial costs of illnesses such as injuries, such as social networks and local community organizations, policy makers can better understand how to protect households from the financial burden of injuries.[11] This study also provided information the relationship between the injured and those who provided help. Among injured individuals who were above the age of 30 years or were female household heads, many of the helpers were their children. Follow-up studies should thus determine if any of these helpers were school age children and if school attendance or enrollment was threatened by the need to care for or assist the injured.

This study fills a gap in the existing literature on the socioeconomic consequences of injuries and can perhaps serve as a platform for a multi-country DSS-based investigation of the relationship between injuries and socioeconomic status in LMICs. Given the establishment of the IM-DSS research site and its regular, on-going data collection on demographic, health and socioeconomic outcomes, there is a promising opportunity to build upon the proposed study to continue examining the effects of injuries over a longer period of time.

References

1. GBD Mortality, Causes of Death Collaborators. Global, regional, and national age–sex specific all-cause and cause-specific mortality for 240 causes of death, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *The Lancet.*385(9963):117-171.
2. Institute for Health Metrics and Evaluation (IHME). GBD Compare. 2015; http://vizhub.healthdata.org/gbd-compare. . Accessed November 5, 2015.
3. Global Road Safety Facility; The World Bank and Institute for Health Metrics and Evaluation. *Transport for Health: The Global Burden of Disease from Motorized Road Transport.* Sealttle, WA2014.
4. Juillard C, Labinjo M, Kobusingye O, Hyder AA. Socioeconomic impact of road traffic injuries in West Africa: exploratory data from Nigeria. *Inj Prev.* 2010;16(6):389-392.
5. Jodha NS. Effectiveness of farmers' adjustments to risk. *Economic and Political Weekly.* 1978:A38-A48.
6. Drèze J. Famine prevention in India. *WIDER Working Papers (UNU).* 1988.
7. Davies S. Are coping strategies a cop out? *IDS bulletin.* 1993;24(4):60-72.
8. Sauerborn R, Adams A, Hien M. Household strategies to cope with the economic costs of illness. *Social science & medicine.* 1996;43(3):291-301.
9. Jayawardene R. Illness perception: social cost and coping-strategies of malaria cases. *Soc Sci Med.* 1993;37(9):1169-1176.
10. Chima RI, Goodman CA, Mills A. The economic impact of malaria in Africa: a critical review of the evidence. *Health policy.* 2003;63(1):17-36.
11. Russell S. The economic burden of illness for households in developing countries: a review of studies focusing on malaria, tuberculosis, and human immunodeficiency virus/acquired immunodeficiency syndrome. *Am J Trop Med Hyg.* 2004;71(2 suppl):147-155.
12. Mutangadura G, Mukurazita D, Jackson H. A review of household and community responses to the HIV/AIDS epidemic in the rural areas of sub-Saharan Africa. 1999.
13. Rugalema G. Coping or struggling? A journey into the impact of HIV/AIDS in southern Africa. *Review of African Political Economy.* 2000;27(86):537-545.
14. Mock CN, Gloyd S, Adjei S, Acheampong F, Gish O. Economic consequences of injury and resulting family coping strategies in Ghana. *Accident; analysis and prevention.* 2003;35(1):81-90.
15. Commission on Social Determinants of Health. *Closing the gap in a generation: health equity through action on the social determinants of health. Final Report of the Commission on Social Determinants of Health.* Geneva: World Health Organization;2008.
16. *WHO Guide to Identifying the Economic Consequences of Disease and Injury.* Gevena, Switzerlind: Department of Health Systems Financing, Health Systems and Services, World Health Organization,;2009.

17. INTERNATIONAL DEVELOPMENT RESEARCH CENTRE. *POPULATION AND HEALTH IN DEVELOPING COUNTRIES: Population, Health, and Survival at INDEPTH Sites, Vol 1.* 2002.
18. Bachani AM, Galiwango E, Kadobera D, et al. A new screening instrument for disability in low-income and middle-income settings: application at the Iganga-Mayuge Demographic Surveillance System (IM-DSS), Uganda. *BMJ Open.* 2014;4(12):e005795.
19. Bachani AM, Hyder AA, Kadobera D, et al. Application of a new instrument to measure injuries and disability at the Iganga-Mayuge demographic surveillance system (im-dss), Uganda. *Injury prevention.* 2012;18(Suppl 1):A92-A92.
20. World Health Organization. *Guidelines for conducting community surveys on injuries and violence.* Geneva, Switzerland 2004.
21. World Bank. *Designing Household Survey Questionnaires for Developing Countries: Lessons from 15 years of the Living Standards Measurement Study.* World Bank;2000.
22. Brislin RW. Back-translation for cross-cultural research. *Journal of cross-cultural psychology.* 1970;1(3):185-216.
23. Sankoh O, Byass P. The INDEPTH Network: filling vital gaps in global epidemiology. *International journal of epidemiology.* 2012;41(3):579-588.
24. Vyas S, Kumaranayake L. Constructing socio-economic status indices: how to use principal components analysis. *Health policy and planning.* 2006;21(6):459-468.
25. Rutstein SO. The DHS Wealth Index: Approaches for rural and urban areas. 2008.
26. Filmer D, Pritchett LH. Estimating wealth effects without expenditure data--or tears: an application to educational enrollments in states of India. *Demography.* 2001;38(1):115-132.
27. Kolenikov S, Angeles G. The use of discrete data in PCA: theory, simulations, and applications to socioeconomic indices. *Chapel Hill: Carolina Population Center, University of North Carolina.* 2004.
28. Galiwango E, Kasunumba N. Personal communication on rural household assets. 2014.
29. Ssewanyana S, Bategeka L. Chronic poverty and economic growth in Uganda: The role of markets. *Chronic Poverty Report.* 2007;8.
30. Uganda Bureau of Statistics. *2002 Uganda Population and Housing Census Analytical Report.* Kampala, Uganda October 2006.
31. Olsson U. Maximum likelihood estimation of the polychoric correlation coefficient. *Psychometrika.* 1979;44(4):443-460.
32. Pearson K. LIII. On lines and planes of closest fit to systems of points in space. *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science.* 1901;2(11):559-572.
33. Howe LD, Hargreaves JR, Huttly SR. Issues in the construction of wealth indices for the measurement of socio-economic position in low-income countries. *Emerg Themes Epidemiol.* 2008;5:3.

34. Browne M, Ortmann G, Hendriks SL. Developing a resilience indicator for food security monitoring and evaluation: Index construction and household classification for six African countries. *Agrekon.* 2014;53(3):31-56.
35. Montgomery MR, Gragnolati M, Burke KA, Paredes E. Measuring living standards with proxy variables. *Demography.* 2000;37(2):155-174.
36. Garenne M, Hohmann-Garenne S. A wealth index to screen high-risk families: application to Morocco. *J Health Popul Nutr.* 2003;21(3):235-242.
37. Peugh JL, Enders CK. Missing data in educational research: A review of reporting practices and suggestions for improvement. *Review of educational research.* 2004;74(4):525-556.
38. Graham JW, Hofer SM, Donaldson SI, MacKinnon DP, Schafer JL. Analysis with missing data in prevention research. *The science of prevention: Methodological advances from alcohol and substance abuse research.* 1997;1:325-366.
39. Schafer JL. Multiple imputation: a primer. *Statistical methods in medical research.* 1999;8(1):3-15.
40. Schafer JL, Graham JW. Missing data: our view of the state of the art. *Psychological methods.* 2002;7(2):147.
41. White IR, Royston P, Wood AM. Multiple imputation using chained equations: Issues and guidance for practice. *Stat Med.* 2011;30(4):377-399.
42. Aldrich JH, Nelson FD. *Linear probability, logit, and probit models.* Vol 45: Sage; 1984.
43. Long JS. *Regression models for categorical and limited dependent variables.* Vol 7: Sage Publications, Incorporated; 1997.
44. Aeron-Thomas A, Jacobs G, Sexton B, Gururaj G, Rahman F. *The involvement and impact if road crashes on the poor: Bangladesh and India case studies* Crowthorne, UK: Transposrt Research Library;2004.
45. Attanayake N, Fox - Rushby J, Mills A. Household costs of 'malaria' morbidity: a study in Matale district, Sri Lanka. *Tropical Medicine & International Health.* 2000;5(9):595-606.
46. Leive A, Xu K. Coping with out-of-pocket health payments: empirical evidence from 15 African countries. *Bull World Health Organ.* 2008;86(11):849-856C.
47. Hoogeveen JG. Measuring welfare for small but vulnerable groups: Poverty and disability in Uganda. *Journal of African Economies.* 2005;14(4):603-631.
48. Aliber MA. Study of the incidence and nature of chronic poverty and development policy in South Africa: an overview. *Chronic Poverty Research Centre Working Paper.* 2001(3).
49. Sen A. Commodities and capabilities. *OUP Catalogue.* 1999.
50. Whitehead M, Dahlgren G, Evans T. Equity and health sector reforms: can low-income countries escape the medical poverty trap? *The Lancet.* 2001;358(9284):833-836.
51. Asenso-Okyere K, Aragon C, Thangata P, Andam K, Mekomen D. HIV/AIDS and farm labour productivity: A review of recent evidence in Africa. *Journal of Development and Agricultural Economics.* 2010;2(12):406-415.

52. de Waal A, Whiteside A. New variant famine: AIDS and food crisis in southern Africa. *Lancet.* 2003;362(9391):1234-1237.
53. Mock C, Acheampong F, Adjei S, Koepsell T. The effect of recall on estimation of incidence rates for injury in Ghana. *International journal of epidemiology.* 1999;28(4):750-755.
54. Somi MF, Butler JR, Vahid F, Njau JD, Kachur SP, Abdulla S. Use of proxy measures in estimating socioeconomic inequalities in malaria prevalence. *Tropical Medicine & International Health.* 2008;13(3):354-364.
55. Ministry of Health. *Health Sector Strategic Plan III: 2010/11 - 2014/2015.* Kampala, Uganda: Government of Uganda;2010.
56. Organization WH. CBR: A Strategy for Rehabilitation, Equalization of Opportunities, Poverty Reduction and, Social Inclusion of People With Disabilities. 2004.
57. Penny N, Zulianello R, Dreise M, Steenbeek M. Community-based rehabilitation and orthopaedic surgery for children with motor impairment in an African context. *Disabil Rehabil.* 2007;29(11-12):839-843.
58. Cohen M, McCord MJ, Sebstad J. Reducing vulnerability: demand for and supply of microinsurance in East Africa. *Journal of International Development.* 2005;17(3):319-325.
59. Brody CM, Bellows N, Campbell M, Potts M. The impact of vouchers on the use and quality of health care in developing countries: a systematic review. *Glob Public Health.* 2013;8(4):363-388.
60. Bellows NM, Bellows BW, Warren C. Systematic Review: the use of vouchers for reproductive health services in developing countries: systematic review. *Tropical medicine & international health : TM & IH.* 2011;16(1):84-96.
61. Lagomarsino G, Garabrant A, Adyas A, Muga R, Otoo N. Moving towards universal health coverage: health insurance reforms in nine developing countries in Africa and Asia. *Lancet.* 2012;380(9845):933-943.
62. Barimah KB, Mensah J. Ghana's National Health Insurance Scheme: insights from members, administrators and health care providers. *J Health Care Poor Underserved.* 2013;24(3):1378-1390.
63. Mensah J, Oppong JR, Schmidt CM. Ghana's National Health Insurance Scheme in the context of the health MDGs: an empirical evaluation using propensity score matching. *Health Econ.* 2010;19 Suppl:95-106.
64. De Waal A, Tumushabe J. HIV/AIDS and food security in Africa. *A report for DFID.* 2003.
65. Ssewamala FM, Ismayilova L. Integrating Children's Savings Accounts in the Care and Support of Orphaned Adolescents in Rural Uganda. *Soc Serv Rev.* 2009;83(3):453-472.
66. Kiiza B, Pederson G. Household financial savings mobilisation: Empirical evidence from Uganda. *Journal of African Economies.* 2001;10(4):390-409.

Table 1. Select variables from IM-DSS core demographic data and socioeconomic data

Variable	Response examples
Demographic	
Name of new born child	Qualitative
Name of deceased	Qualitative
Age of deceased	Numeric
Sex of usual household resident	Female/male
Year of birth of usual household resident	Numeric
Marital status of resident	Single, married, separated/divorced, co-habit, widowed
Names of persons who usually live in the household	Qualitative
Relationship of usual residents to the household head	Household head, wife, child, parent, grandparent, sister, uncle, not related
Did usual resident sleep in household last night	Yes/no
Did usual resident, who did not sleep in household last night, leave the household less than four months ago	Yes/no
Reason for individual's change in residence	Family related, security related, housing related, job related, cost related, education related
Relationship between household in-migrant and household head	Household head, wife, child, parent, grandparent, sister, uncle, not related
Sex of household in-migrant	Female/male
Basic reason for household in-migration	Build or form a new household Join an existing household
Reason for household in-migration	Family-, security-, housing-, job-, cost-, and education-related
Socioeconomic	
Formal employment of the head of household	Agriculture, trade, formal employment, laborer (wage earner), remittances, fishing, other
Occupation of the head of household	Shop/business, bodaboda/taxi, professional, farmer/agriculture, market vender, laborer (wage), mechanical work, other
Main source of drinking water	Taps, tanks, piped water into residence/compound/plot, well on residence/plot, unprotected spring, borehole
Type of dwelling	Independent house, basement, shared house, hut
Main roof material	Grass thatched, plastic sheet, carbonated sheets, wood/timber, metal sheets, iron sheets, tiles, cement, other
Total number of rooms	Quantitative
Owns cattle	Yes/no

Table 2. Variables for Analyses

Variable	Values
Sociodemographic	
Sex	Binary variable for male and female
Age	Continuous
Relationship to household head	Categorical variable where responses include brother, other, parent-in-law, sister, not related, wife, parent, grandparent, husband, brother-in-law, unknown relationship, child, sister-in-law, grandchild, son-in-law, daughter-in-law, co-wife, self, aunt, nephew, niece, step child, step parent, and uncle
Occupation of the head of household	Categorical variable where responses include shop/business, bodaboda/taxi, professional, farmer/agriculture, market vender, laborer (wage), mechanical work, and other
Household socioeconomic status	Numerous categorical and numerical asset variables
Household location	Categorical variable uniquely identifying household's village location
Injury	
Cause of injury	Categorical variable where responses include traffic; pedestrian; occupant; cyclist; unintentional fall; burn; gun shot; stab; blunt injury; poisoning; drowning; dog, snake or other animal bite; landmine; other causes
Type of most recent injury	Categorical where responses include road or traffic injury, intentional violence-related injury, poisoning, burns, drowning or near drowning, dog, snake, or animal bite, unintentional fall, and other
Ability to resume usual activities	One categorical variable on length of inability to resume activity among those who were unable to resume for more than one day, where responses include between one to six days, between one to four weeks, and for more than on month
Time since injury	Three numeric variables on reported date, month, and year of injury
Hospital admission	Binary variable for whether the injured was admitted to the facility
Surgery	Binary variable for whether injury required surgery
Cost	Numerical variable on cost of transport to initial care
Ability to return to previous occupation	Categorical variable where responses include yes, no, and don't know
Number of work days	Continuous

Table 3. Assets selected for the asset index as a measure of household wealth

Asset variable	Type of Asset Index ("X" indicates inclusion)		
	Principal Components Analysis		
	Type of Correlation		Simple Sum of Assets
	Polychoric	Pearson's	
Material			
Roof	X		X
Wall	X	X	X
Floor	X	X	X
Total number			
Rooms	X		X
Sleeping rooms	X	X	X
Main source			
Light	X		X
Toilet			
Drinking water			
Garbage disposal			
Availability			
Shutters			
Handwashing facility			
Owns			
Land			
Mattress	X		X
Table	X		X
Bednet	X		X
Gas or electric cooker			
Kerosene stove	X		X
Charcoal iron	X	X	X
Electric iron	X		X
Television set	X		X
Radio	X	X	X
Mobile phone	X		X
Stereo	X		X
Phone			
Camera	X		X
Motorcycle	X		X
Bicycle	X	X	X
Car			
Refrigerator	X		X
Sewing machine	X	X	X
Panga	X		X
Wheelbarrow	X	X	X
Plough	X		X
Axe	X		X
Cattle	X		X
Sheep	X		X
Goat	X		X
Chicken	X		X
Pig			

Asset variable	Type of Asset Index ("X" indicates inclusion)		
	Principal Components Analysis		Simple Sum of Assets
	Type of Correlation		
	Polychoric	Pearson's	
Quantity currently in storage			
Maize			
Beans			
Millet			
Groundnuts			
Rice			
Cassava			
Stores food	X		X

Table 4. Recoding categorical asset variables for wealth index based on simple sum of assets

	Asset variable	Variable Coding for Asset Index: Principal Components Analysis	Variable Coding for Asset Index: Simple Sum of Assets
Material			
Roof	Grass, thatched, or plastic	1	0
	Wood or timber	2	
	Carbonated, metal or iron sheets	3	1
	Asbestos, tiles, or cement	4	
Wall	Mud, poles, or thatched	1	0
	Iron, carbonated, or metal sheets or unburnt bricks	2	
	Burnt bricks or cement blocks	3	1
	Wood or timber	4	
Floor	Earth or earth and dung	1	0
	Sand or gravel	2	
	Cement or wood planks	3	1
Total number			
Rooms	One	1	0
	Two	2	
	Three to ten	3	1
	Eleven or more	4	
Sleeping rooms	One	1	0
	Two	2	
	Three to ten	3	1
	Eleven or more	4	
Main source of light			
	Firewood	1	0
	Paraffin or wax candle	2	
	Paraffin or kerosene lantern	3	1
	Solar or electricity	4	

Table 5. Injured characteristics by their household's village development (n=749)

	% (No.)		Pearson χ2 statistic
	Peri-urban	Rural	(p-value)
Gender			
Female	37.8 (31)	36.9 (246)	0.03 (0.87)
Male	62.2 (51)	63.1 (421)	
Age (years)			
Under five	11 (9)	10.2 (68)	2.7 (0.743)
Five to <15	23.2 (19)	26.5 (177)	
15 to <30	28 (23)	21.4 (143)	
30 to <45	19.5 (16)	18.7 (125)	
45 to <60	9.8 (8)	13.6 (91)	
60 and older	8.5 (7)	9.4 (63)	
Occupation			
Not earning income	42.7 (35)	48.3 (322)	57.8 (<0.0001)
Professional or shop/business	18.3 (15)	6.4 (43)	
Bodaboda/taxi	2.4 (2)	7.9 (53)	
Farmer/Agriculture	4.9 (4)	24.7 (165)	
Vendor	18.3 (15)	4 (27)	
Mechanical/construction	7.3 (6)	4.5 (30)	
Laborer	6.1 (5)	4 (27)	
Household head occupation (n=738)*			
Professionals	14.1 (11)	4.8 (32)	102.2 (<0.0001)
Shop/business	53.8 (42)	14.5 (96)	
Bodaboda drivers	5.1 (4)	8.3 (55)	
Farmer/agriculture	1.3 (1)	45.5 (300)	
Mechanical, vender, laborer	17.9 (14)	18 (119)	
Household head sex (n=738)*			
Male	77.9 (60)	82.6 (537)	1.03 (0.31)
Female	22.1 (17)	17.4 (113)	

* Smaller sample sizes are due to missing data

Table 6. Sample characteristics in the rural IM-DSS sample (n=649)

	% (No.)
Gender	
Female	37.0 (240)
Male	63.0 (409)
Age (years)	
Under five	10.0 (65)
Five to <15	26.7 (173)
15 to <30	21.1 (137)
30 to <45	18.3 (119)
45 to <60	13.9 (92)
60 and older	10.0 (65)
Occupation	
Shop/business	5.4 (35)
Bodaboda/taxi	7.9 (51)
Professional	1.2 (8)
Farmer/Agriculture	24.8 (161)
Vendor	4.0 (26)
Laborer	4.0 (26)
Mechanical	0.9 (6)
Construction	3.7 (24)
Student	37.0 (240)
Homemaker	0.8 (5)
Unemployed	1.8 (11)
Preschool child	8.5 (55)
Relationship to household head	
Child or grandchild	50.8 (330)
Household head	10.6 (69)
Wife	3.7 (24)
Other	34.8 (226)
Household head occupation (n=642)*	
Shop/Business	14.6 (96)
Bodaboda/Taxi	8.1 (52)
Professional	4.8 (31)
Farmer/Agriculture	45.6 (293)
Market vender	0.6 (4)
Laborer	14.6 (94)
Mechanical work	2.8 (18)
Other	8.7 (56)
Household head sex (n=633)	
Male	82.3 (521)
Female	17.7 (112)
Wealth quintile (n=555)*	
Lowest	12.3 (68)
Second lowest	17.8 (99)
Middle	16.8 (93)
Second highest	28.8 (160)
Highest	24.3 (135)

* Smaller sample sizes are due to missing data

Table 7. Injury characteristics in the rural IM-DSS sample (n=649)

	% (No.)
Type of injury	
Road traffic injury	44.1 (286)
Unintentional fall	27.6 (179)
Burn	9.6 (62)
Intentional violence-related	5.4 (35)
Stab or cut	7.7 (50)
Animal bite	2.6 (17)
Blunt	2.0 (13)
Poisoning	1.1 (7)
Months elapsed between injury event and date of interview	
Less than three	6.9 (45)
Three to six	11.2 (73)
Six to 12	22.5 (146)
12 to 18	8.0 (52)
18 to 24	20.8 (135)
24 to 36	30.5 (198)
Received care at the scene of the injury	
Yes	70.0 (454)
No	29.1 (189)
Don't know	0.9 (6)
Time elapsed between injury event and resumption of usual activities (n=643)*	
Between one and six days	23.5 (151)
Between 7 to 29 days	52.7 (339)
More than one month	23.8 (154)

* Smaller sample sizes are due to missing data

Table 8. Characteristics of first time care after the scene of the injury in the rural IM-DSS sample (n=643)

	% (No.)
Type of transport to care site	
Motorcycle	39.7 (255)
Bicycle	34.1 (219)
By foot	11.8 (76)
No transported/stayed at scene	9.5 (61)
Ambulance	1.4 (9)
Personal vehicle	1.1 (7)
Other	2 (13)
Don't know	0.5 (3)
Cost of transport to care site (USD) (n=633)	
None	64.3 (407)
>0 to 1	22.3 (141)
>2	13.4 (85)
Where first time care was received (n=649)	
Hospital	35.7 (232)
Private clinic	34.4 (223)
Traditional practitioner	16.6 (108)
Health center	6.8 (44)
Pharmacy/drug store	3.7 (24)
Home	2 (13)
Other	0.8 (5)
Cost of care (USD) (n=606)	
No cost	13.4 (81)
>0 to 1	13.9 (84)
>1 to 2	20 (121)
>2 to 7	24.1 (146)
>7	28.7 (174)
Sum of transport and care costs (n=597)	
None	9.7 (58)
>0 to 1	16.1 (96)
>1 to 5	38.2 (228)
>5 to 10	17.3 (103)
>10 to 20	12.4 (74)
>20	6.4 (38)

* Smaller sample sizes are due to missing data. The frequency and percentage of the sum of transport and care costs variable are restricted to individuals who have data for both transport costs and care costs.

Table 9. Household socioeconomic consequences of the most recent injury in the rural IM-DSS sample (n=643)

Reported decrease in household…	% (No.)	
Income (n=643)		
No	14.9 (96)	
Yes	85.1 (547)	
Food purchases	Entire sample (n=605)	Individuals from households where the main source of food was purchased food (n=62)
No	58.2 (352)	51.6 (32)
Yes	41.8 (253)	48.4 (30)
Food production	Entire sample (n=740)	Individuals from households where the main source of food was household-grown food (n=476)
No	40.8 (261)	36.3 (173)
Yes	59.2 (379)	63.7 (303)

* Smaller sample sizes are due to missing data.

Table 10. Rural IM-DSS odds ratios for reported decrease in household income due to an injury by sociodemographic and injury characteristics (n=643)

Variable	Odds ratio 95% CI p-value Model 1 (PCA-based) Unadjusted	Adjusted	Model 2 (Simple sum-based) Unadjusted	Adjusted
Sex				
Female	1.0	1.0	1.0	1.0
Male	1.7 (1.13, 2.57) 0.012	1.44 (0.91, 2.28) 0.118	1.7 (1.13, 2.57) 0.012	1.48 (0.94, 2.32) 0.087
Age group at the time of the injury				
Under 15	1.0	1.0	1.0	1.0
15 to <30	1.84 (1, 3.37) 0.049	1.48 (0.74, 2.97) 0.265	1.87 (1.04, 3.36) 0.037	1.52 (0.76, 3.03) 0.233
30 to <45	2.85 (1.08, 7.48) 0.034	2.1 (0.81, 5.45) 0.128	3.02 (1.14, 8.01) 0.026	2.28 (0.89, 5.82) 0.085
45 to <60	1.68 (0.76, 3.73) 0.203	1.48 (0.61, 3.6) 0.385	1.71 (0.77, 3.77) 0.184	1.52 (0.63, 3.71) 0.352
Over 60	1.13 (0.65, 1.94) 0.666	0.92 (0.42, 2) 0.824	1.17 (0.68, 2.02) 0.573	0.92 (0.42, 2.03) 0.835
Household head occupation				
Professionals	1.0	1.0	1.0	1.0
Shop/business	2.19 (0.84, 5.7) 0.109	1.18 (0.33, 4.23) 0.802	2.19 (0.84, 5.69) 0.108	1.27 (0.35, 4.66) 0.714
Bodaboda/taxi drivers	2.23 (0.82, 6.12) 0.117	0.8 (0.21, 3.01) 0.741	2.22 (0.81, 6.07) 0.121	0.89 (0.23, 3.37) 0.862
Farmer/Agriculture	1.41 (0.79, 2.54) 0.248	0.76 (0.3, 1.93) 0.561	1.41 (0.79, 2.54) 0.247	0.88 (0.36, 2.15) 0.785
Mechanical work, vender, or laborer	2.05 (0.94, 4.49) 0.071	1.11 (0.37, 3.34) 0.847	2.06 (0.94, 4.49) 0.071	1.26 (0.45, 3.54) 0.657
Other	1.47 (0.6, 3.63) 0.399	0.82 (0.26, 2.63) 0.74	1.48 (0.6, 3.63) 0.397	0.98 (0.31, 3.12) 0.97
Wealth quintile				
Highest	1.0	1.0	1.0	1.0
Second highest	1.21 (0.63, 2.35) 0.569	1.48 (0.66, 3.32) 0.336	1.26 (0.67, 2.36) 0.468	1.33 (0.65, 2.72) 0.437
Middle	2.84 (1.12, 7.19) 0.027	3.45 (1.24, 9.62) 0.018	1.82 (0.81, 4.12) 0.149	1.84 (0.81, 4.17) 0.142
Second lowest	1.27 (0.63, 2.58) 0.506	1.61 (0.68, 3.82) 0.279	1.54 (0.75, 3.18) 0.238	1.67 (0.73, 3.83) 0.229
Lowest	1.69	2.31	1.43	1.74

Variable	Odds ratio 95% CI p-value Model 1 (PCA-based) Unadjusted	 Adjusted	 Model 2 (Simple sum-based) Unadjusted	 Adjusted
	(0.64, 4.48) 0.293	(0.77, 6.95) 0.137	(0.62, 3.31) 0.397	(0.65, 4.66) 0.273
Household head sex				
Male	1.0	1.0	1.0	1.0
Female	1.36 (0.76, 2.45) 0.303	1.62 (0.79, 3.32) 0.185	1.4 (0.78, 2.52) 0.263	1.64 (0.83, 3.26) 0.157
Type of injury				
Unintentional fall	1.0	1.0	1.0	1.0
Road traffic injury	1.65 (1.02, 2.67) 0.043	1.27 (0.71, 2.28) 0.422	1.65 (1.02, 2.67) 0.043	1.23 (0.68, 2.2) 0.493
Other	0.85 (0.57, 1.26) 0.425	0.74 (0.44, 1.24) 0.254	0.85 (0.57, 1.26) 0.425	0.76 (0.46, 1.27) 0.295
Months elapsed since injury				
Less than six	1.0	1.0	1.0	1.0
Six to <12	1.27 (0.53, 3.07) 0.589	1.14 (0.48, 2.71) 0.762	1.27 (0.53, 3.07) 0.589	1.1 (0.47, 2.61) 0.821
12 to <24	1.31 (0.68, 2.5) 0.42	1.21 (0.64, 2.28) 0.555	1.31 (0.68, 2.5) 0.42	1.18 (0.63, 2.23) 0.599
24 to 36	1.67 (0.78, 3.58) 0.187	1.31 (0.57, 3) 0.52	1.67 (0.78, 3.58) 0.187	1.28 (0.56, 2.88) 0.558
Number of days respondent was unable to resume usual activities				
One to six	1.0	1.0	1.0	1.0
>Six	4.8 (2.94, 7.84) <0.0001	3.86 (2.29, 6.5) <0.0001	4.8 (2.94, 7.84) <0.0001	3.8 (2.34, 6.19) <0.0001
Cost of first time care including transport (USD)				
Less than two	1.0	1.0	1.0	1.0
>2 to 4	2.48 (1.4, 4.39) 0.002	2.1 (1.22, 3.64) 0.008	2.43 (1.34, 4.39) 0.003	2.13 (1.21, 3.77) 0.009
>4	6.27 (2.79, 14.1) <0.0001	4.27 (1.7, 10.74) 0.002	6.15 (2.73, 13.83) <0.0001	4.18 (1.71, 10.24) 0.002

*Odds ratios adjusted for all variables listed in the table

Table 11. Rural IM-DSS odds ratios for reported decrease in household food purchases due to an injury by sociodemographic and injury characteristics (n=605)

Variable	Odds ratio 95% CI p-value Model 1 (PCA-based) Unadjusted	 Adjusted	 Model 2 (Simple sum-based) Unadjusted	 Adjusted
Sex				
Female	1.0	1.0	1.0	1.0
Male	1.1 (0.79, 1.52) 0.566	0.97 (0.67, 1.42) 0.887	1.1 (0.79, 1.52) 0.566	0.99 (0.68, 1.45) 0.974
Age group at the time of the injury				
Under 15	1.0	1.0	1.0	1.0
15 to <30	1.38 (0.9, 2.12) 0.144	1.05 (0.54, 2.06) 0.884	1.38 (0.9, 2.12) 0.14	1.07 (0.58, 1.98) 0.828
30 to <45	2.42 (1.29, 4.51) 0.006	1.83 (0.76, 4.42) 0.18	2.44 (1.31, 4.53) 0.005	1.9 (0.83, 4.31) 0.126
45 to 59	1.63 (0.93, 2.86) 0.089	1.43 (0.52, 3.92) 0.488	1.65 (0.95, 2.88) 0.078	1.48 (0.59, 3.73) 0.403
60 and older	1.46 (0.79, 2.68) 0.224	1.52 (0.58, 4.02) 0.395	1.46 (0.8, 2.66) 0.223	1.53 (0.62, 3.73) 0.354
Occupation				
Not earning an income	1.0	1.0	1.0	1.0
Shop/business or professional	1.73 (0.92, 3.23) 0.087	0.81 (0.35, 1.89) 0.631	1.73 (0.92, 3.23) 0.087	0.8 (0.36, 1.79) 0.584
Bodaboda/taxi	3.27 (1.67, 6.41) 0.001	1.57 (0.61, 4.09) 0.352	3.27 (1.67, 6.41) 0.001	1.61 (0.64, 4.07) 0.312
Farmer/agriculture	1.45 (0.91, 2.3) 0.118	1.06 (0.48, 2.33) 0.888	1.45 (0.91, 2.3) 0.118	1.05 (0.51, 2.16) 0.904
Vendor, laborer, construction, and mechanical work	1.9 (1.06, 3.39) 0.03	1.43 (0.63, 3.24) 0.396	1.9 (1.06, 3.39) 0.03	1.35 (0.61, 3) 0.455
Household head occupation				
Professionals or shop/business	1.0	1.0	1.0	1.0
Bodaboda/taxi drivers or mechanical work	2.03 (1.07, 3.84) 0.031	1.49 (0.76, 2.89) 0.243	2.03 (1.07, 3.85) 0.031	1.56 (0.79, 3.06) 0.198
Farmer/Agriculture	1.16 (0.72, 1.86) 0.548	1.25 (0.76, 2.03) 0.38	1.16 (0.72, 1.86) 0.55	1.3 (0.81, 2.1) 0.278
Vender, laborer, or other	1.1 (0.69, 1.77) 0.682	1.24 (0.72, 2.13) 0.445	1.11 (0.69, 1.78) 0.669	1.27 (0.75, 2.14) 0.38
Wealth quintile				
Highest	1.0	1.0	1.0	1.0
Second highest	1.11 (0.69, 1.78)	1.14 (0.69, 1.91)	1.04 (0.71, 1.52)	1 (0.67, 1.48)

Variable	Odds ratio 95% CI p-value Model 1 (PCA-based) Unadjusted	 Adjusted	 Model 2 (Simple sum-based) Unadjusted	 Adjusted
	0.668	0.608	0.834	0.983
Middle	1.22 (0.72, 2.05) 0.46	1.11 (0.62, 2) 0.726	1.38 (0.75, 2.54) 0.3	1.27 (0.71, 2.28) 0.416
Second lowest	0.73 (0.37, 1.46) 0.373	0.72 (0.35, 1.48) 0.368	0.79 (0.44, 1.43) 0.444	0.71 (0.37, 1.38) 0.312
Lowest	0.81 (0.49, 1.33) 0.399	0.81 (0.45, 1.46) 0.489	0.84 (0.49, 1.44) 0.533	0.82 (0.45, 1.49) 0.51
Household head sex				
Male	1.0	1.0	1.0	1.0
Female	1.08 (0.72, 1.62) 0.693	1.23 (0.73, 2.06) 0.432	1.1 (0.73, 1.65) 0.661	1.23 (0.73, 2.08) 0.433
Type of injury				
Unintentional fall	1.0	1.0	1.0	1.0
Road traffic injury	1.61 (1.14, 2.29) 0.008	1.15 (0.72, 1.85) 0.558	1.61 (1.14, 2.29) 0.008	1.15 (0.71, 1.84) 0.574
Burn	1.51 (0.94, 2.44) 0.09	1.42 (0.78, 2.6) 0.25	1.51 (0.94, 2.44) 0.09	1.38 (0.76, 2.5) 0.297
Other	0.82 (0.52, 1.29) 0.4	0.67 (0.43, 1.06) 0.086	0.82 (0.52, 1.29) 0.4	0.68 (0.43, 1.09) 0.106
Months elapsed since injury				
Less than six	1.0	1.0	1.0	1.0
Six to <12	1.11 (0.51, 2.4) 0.795	0.95 (0.41, 2.19) 0.904	1.11 (0.51, 2.4) 0.795	0.93 (0.4, 2.15) 0.869
12 to <24	1.7 (0.95, 3.04) 0.071	1.41 (0.73, 2.71) 0.307	1.7 (0.95, 3.04) 0.071	1.4 (0.73, 2.69) 0.315
24 to 36	1.99 (1.1, 3.6) 0.023	1.58 (0.85, 2.92) 0.148	1.99 (1.1, 3.6) 0.023	1.56 (0.83, 2.94) 0.171
Number of days respondent was unable to resume usual activities				
One to six	1.0	1.0	1.0	1.0
>Six	2.29 (1.47, 3.57) <0.0001	1.51 (0.91, 2.5) 0.108	2.29 (1.47, 3.57) <0.0001	1.47 (0.91, 2.4) 0.118
Cost of first time care including transport (USD)				
Less than two	1.0	1.0	1.0	1.0
>2 to 4	2.63 (1.46, 4.71) 0.001	2.39 (1.33, 4.28) 0.003	2.73 (1.51, 4.94) 0.001	2.47 (1.37, 4.45) 0.003
>4	4.81 (3.17, 7.31) <0.0001	4.07 (2.61, 6.33) <0.0001	4.89 (3.2, 7.46) <0.0001	4.18 (2.68, 6.51) <0.0001

Table 12. Rural IM-DSS odds ratios for reported decrease in household food production due to an injury by sociodemographic and injury characteristics (n=640)

Variable	Odds ratio 95% CI p-value Model 1 (PCA-based)		Model 2 (Simple sum-based)	
	Unadjusted	Adjusted	Unadjusted	Adjusted
Sex				
Female	1.0	1.0	1.0	1.0
Male	1.14 (0.7, 1.84) 0.605	1.35 (0.81, 2.24) 0.249	1.14 (0.7, 1.84) 0.605	1.31 (0.68, 2.51) 0.423
Age group at the time of the injury				
Under 15	1.0	1.0	1.0	1.0
15 to <30	1.22 (0.77, 1.94) 0.404	0.8 (0.46, 1.41) 0.447	1.22 (0.77, 1.92) 0.394	0.94 (0.47, 1.9) 0.861
30 to <45	1.41 (0.77, 2.56) 0.265	0.8 (0.31, 2.02) 0.632	1.38 (0.76, 2.51) 0.288	1.24 (0.34, 4.48) 0.748
Over 45	2.71 (1.62, 4.55) <0.0001	1.5 (0.55, 4.12) 0.427	2.71 (1.62, 4.52) <0.0001	3 (0.92, 9.76) 0.068
Occupation				
Not earning an income	1.0	1.0	1.0	1.0
Shop/business or professional	2.58 (1.1, 6.02) 0.029	0.95 (0.36, 2.53) 0.919	2.58 (1.1, 6.02) 0.029	0.86 (0.19, 4.02) 0.851
Bodaboda/taxi	1.5 (0.67, 3.37) 0.324	1.09 (0.47, 2.53) 0.848	1.5 (0.67, 3.37) 0.324	0.6 (0.19, 1.93) 0.39
Farmer/agriculture	2.24 (1.29, 3.88) 0.004	1.9 (0.88, 4.12) 0.103	2.24 (1.29, 3.88) 0.004	1.17 (0.4, 3.38) 0.775
Vendor, laborer, construction, and mechanical work	1.25 (0.68, 2.28) 0.472	0.73 (0.31, 1.68) 0.455	1.25 (0.68, 2.28) 0.472	0.62 (0.21, 1.8) 0.377
Household head occupation				
Professionals or shop/business	1.0	1.0	1.0	1.0
Bodaboda/taxi drivers or mechanical work	2.06 (1.01, 4.2) 0.046	2.27 (0.98, 5.26) 0.056	2.06 (1.01, 4.2) 0.046	1.29 (0.53, 3.14) 0.581
Farmer/Agriculture	1.36 (0.8, 2.33) 0.262	1.68 (0.89, 3.18) 0.109	1.36 (0.8, 2.33) 0.262	0.96 (0.51, 1.83) 0.908
Vender, laborer, or other	1.18 (0.7, 1.98) 0.531	1.29 (0.77, 2.17) 0.338	1.18 (0.7, 1.98) 0.531	0.88 (0.46, 1.68) 0.697
Wealth quintile				
Highest	1.0	1.0	1.0	1.0
Second highest	1.44 (0.84, 2.48) 0.189	1.56 (0.88, 2.78) 0.127	1.37 (0.78, 2.39) 0.276	1.56 (0.78, 3.15) 0.212
Middle	1.43	1.46	0.98	1.08

Variable	Odds ratio 95% CI p-value Model 1 (PCA-based) Unadjusted	Adjusted	Model 2 (Simple sum-based) Unadjusted	Adjusted
	(0.79, 2.58) 0.233	(0.81, 2.64) 0.211	(0.51, 1.89) 0.954	(0.54, 2.15) 0.83
Second lowest	1.35 (0.8, 2.28) 0.256	1.32 (0.77, 2.28) 0.316	1.25 (0.69, 2.25) 0.458	1.6 (0.77, 3.32) 0.211
Lowest	2.52 (1.24, 5.1) 0.011	2.39 (1.15, 4.98) 0.02	2.36 (1.4, 4.01) 0.001	3.26 (1.62, 6.53) 0.001
Household head sex				
Male	1.0	1.0	1.0	1.0
Female	1.17 (0.69, 2) 0.558	1.18 (0.66, 2.11) 0.574	1.17 (0.69, 2) 0.558	0.89 (0.42, 1.92) 0.776
Type of injury				
Unintentional fall	1.0	1.0	1.0	1.0
Road traffic injury	1.36 (0.82, 2.26) 0.23	0.92 (0.56, 1.51) 0.749	1.36 (0.82, 2.26) 0.23	1.32 (0.68, 2.54) 0.415
Burn	1.86 (0.87, 3.97) 0.111	1.56 (0.83, 2.92) 0.168	1.86 (0.87, 3.97) 0.111	2.12 (0.83, 5.39) 0.115
Other	1.07 (0.64, 1.8) 0.791	0.75 (0.47, 1.18) 0.215	1.07 (0.64, 1.8) 0.791	0.94 (0.54, 1.63) 0.824
Months elapsed since injury				
Less than six	1.0	1.0	1.0	1.0
Six to <12	0.82 (0.46, 1.47) 0.507	0.84 (0.46, 1.54) 0.572	0.82 (0.46, 1.47) 0.507	0.61 (0.33, 1.11) 0.103
12 to <24	0.85 (0.49, 1.46) 0.557	0.83 (0.49, 1.41) 0.49	0.85 (0.49, 1.46) 0.557	0.59 (0.3, 1.17) 0.134
24 to 36	1.24 (0.68, 2.29) 0.482	1.27 (0.72, 2.23) 0.406	1.24 (0.68, 2.29) 0.482	0.92 (0.49, 1.72) 0.786
Number of days respondent was unable to resume usual activities				
One to six	1.0	1.0	1.0	1.0
>Six	4.31 (2.88, 6.44) <0.0001	2.96 (1.87, 4.66) <0.0001	4.31 (2.88, 6.44) <0.0001	3.21 (1.96, 5.25) <0.0001
Cost of first time care including transport (USD)				
Less than two	1.0	1.0	1.0	1.0
>2 to 4	1.95 (1.15, 3.31) 0.013	2.16 (1.14, 4.09) 0.018	2.01 (1.16, 3.47) 0.012	2.18 (1.18, 4.04) 0.013
>4	7.18 (4.49, 11.47)	4.05 (2.61, 6.29)	3.18 (1.93, 5.22)	4.31 (2.88, 6.44)

	Odds ratio 95% CI p-value			
Variable	Model 1 (PCA-based)		Model 2 (Simple sum-based)	
	Unadjusted	Adjusted	Unadjusted	Adjusted
	<0.0001	<0.0001	<0.0001	<0.0001

Table 13. Rural IM-DSS odds ratios for reported decrease in household food production due to an injury by sociodemographic and injury characteristics among individuals who were mostly consumed household-grown food (n=454)

Variable	Odds ratio 95% CI p-value Model 1 (PCA-based) Unadjusted	 Adjusted	 Model 2 (Simple sum-based) Unadjusted	 Adjusted
Sex				
Female	1.0	1.0	1.0	1.0
Male	1.14 (0.7, 1.84) 0.605	1.34 (0.7, 2.56) 0.38	1.14 (0.7, 1.84) 0.605	1.31 (0.68, 2.51) 0.423
Age group at the time of the injury				
Under 15	1.0	1.0	1.0	1.0
15 to <30	1.22 (0.77, 1.94) 0.404	1 (0.49, 2.04) 0.999	1.22 (0.77, 1.92) 0.394	0.94 (0.47, 1.9) 0.861
30 to <45	1.41 (0.77, 2.56) 0.265	1.27 (0.36, 4.52) 0.711	1.38 (0.76, 2.51) 0.288	1.24 (0.34, 4.48) 0.748
Over 45	2.71 (1.62, 4.55) <0.0001	3.11 (0.96, 10.06) 0.058	2.71 (1.62, 4.52) <0.0001	3 (0.92, 9.76) 0.068
Occupation				
Not earning an income	1.0	1.0	1.0	1.0
Shop/business or professional	2.58 (1.1, 6.02) 0.029	0.89 (0.19, 4.12) 0.885	2.58 (1.1, 6.02) 0.029	0.86 (0.19, 4.02) 0.851
Bodaboda/taxi	1.5 (0.67, 3.37) 0.324	0.6 (0.2, 1.84) 0.372	1.5 (0.67, 3.37) 0.324	0.6 (0.19, 1.93) 0.39
Farmer/agriculture	2.24 (1.29, 3.88) 0.004	1.21 (0.42, 3.43) 0.726	2.24 (1.29, 3.88) 0.004	1.17 (0.4, 3.38) 0.775
Vendor, laborer, construction, and mechanical work	1.25 (0.68, 2.28) 0.472	0.61 (0.21, 1.73) 0.35	1.25 (0.68, 2.28) 0.472	0.62 (0.21, 1.8) 0.377
Household head occupation				
Professionals or shop/business	1.0	1.0	1.0	1.0
Bodaboda/taxi drivers or mechanical work	2.06 (1.01, 4.2) 0.046	1.37 (0.57, 3.32) 0.482	2.06 (1.01, 4.2) 0.046	1.29 (0.53, 3.14) 0.581
Farmer/Agriculture	1.36 (0.8, 2.33) 0.262	0.95 (0.5, 1.8) 0.867	1.36 (0.8, 2.33) 0.262	0.96 (0.51, 1.83) 0.908
Vender, laborer, or other	1.18 (0.7, 1.98) 0.531	0.88 (0.48, 1.64) 0.693	1.18 (0.7, 1.98) 0.531	0.88 (0.46, 1.68) 0.697
Wealth quintile				
Highest	1.0	1.0	1.0	1.0
Second highest	1.44 (0.84, 2.48) 0.189	1.73 (0.87, 3.42) 0.117	1.37 (0.78, 2.39) 0.276	1.56 (0.78, 3.15) 0.212

Variable	Odds ratio 95% CI p-value Model 1 (PCA-based) Unadjusted	Adjusted	Model 2 (Simple sum-based) Unadjusted	Adjusted
Middle	1.43 (0.79, 2.58) 0.233	1.71 (0.81, 3.59) 0.157	0.98 (0.51, 1.89) 0.954	1.08 (0.54, 2.15) 0.83
Second lowest	1.35 (0.8, 2.28) 0.256	2.03 (1.07, 3.87) 0.031	1.25 (0.69, 2.25) 0.458	1.6 (0.77, 3.32) 0.211
Lowest	2.52 (1.24, 5.1) 0.011	3.27 (1.35, 7.95) 0.009	2.36 (1.4, 4.01) 0.001	3.26 (1.62, 6.53) 0.001
Household head sex				
Male	1.0	1.0	1.0	1.0
Female	1.17 (0.69, 2) 0.558	0.89 (0.43, 1.85) 0.757	1.17 (0.69, 2) 0.558	0.89 (0.42, 1.92) 0.776
Type of injury				
Unintentional fall	1.0	1.0	1.0	1.0
Road traffic injury	1.36 (0.82, 2.26) 0.23	1.26 (0.65, 2.43) 0.492	1.36 (0.82, 2.26) 0.23	1.32 (0.68, 2.54) 0.415
Burn	1.86 (0.87, 3.97) 0.111	2.06 (0.84, 5.01) 0.113	1.86 (0.87, 3.97) 0.111	2.12 (0.83, 5.39) 0.115
Other	1.07 (0.64, 1.8) 0.791	0.91 (0.53, 1.58) 0.739	1.07 (0.64, 1.8) 0.791	0.94 (0.54, 1.63) 0.824
Months elapsed since injury				
Less than six	1.0	1.0	1.0	1.0
Six to <12	0.82 (0.46, 1.47) 0.507	0.6 (0.34, 1.06) 0.081	0.82 (0.46, 1.47) 0.507	0.61 (0.33, 1.11) 0.103
12 to <24	0.85 (0.49, 1.46) 0.557	0.59 (0.3, 1.19) 0.141	0.85 (0.49, 1.46) 0.557	0.59 (0.3, 1.17) 0.134
24 to 36	1.24 (0.68, 2.29) 0.482	0.9 (0.48, 1.68) 0.736	1.24 (0.68, 2.29) 0.482	0.92 (0.49, 1.72) 0.786
Number of days respondent was unable to resume usual activities				
One to six	1.0	1.0	1.0	1.0
>Six	4.31 (2.88, 6.44) <0.0001	3.18 (1.93, 5.22) <0.0001	4.31 (2.88, 6.44) <0.0001	3.21 (1.96, 5.25) <0.0001
Cost of first time care including transport (USD)				
Less than two	1.0	1.0	1.0	1.0
>2 to 4	1.95 (1.15, 3.31) 0.013	2.11 (1.15, 3.87) 0.016	2.01 (1.16, 3.47) 0.012	2.18 (1.18, 4.04) 0.013
>4	7.18	4.31	3.18	4.31

Variable	Odds ratio 95% CI p-value			
	Model 1 (PCA-based)		Model 2 (Simple sum-based)	
	Unadjusted	Adjusted	Unadjusted	Adjusted
	(4.49, 11.47) <0.0001	(2.88, 6.44) <0.0001	(1.93, 5.22) <0.0001	(2.88, 6.44) <0.0001

Table 14. Receipt of help due to difficulty with resuming usual activities in the rural IM-DSS sample (n=649)

	% (No.)
Received help for difficulty with the injury	
Yes	90.0 (584)
No	10.0 (65)
Among individuals who received help (n=584)	
Type of help received (n=582)*	
Necessities such as food, soap, and clothing	75.3 (438)
Services such as house help or child care	14.8 (86)
Money	8.4 (49)
Transportation	1.2 (7)
Other	0.3 (2)
Where the person who provided help lives (n=583)*	
Same house	89.4 (521)
Same village	6.5 (38)
Different village	4.1 (24)
Relationship to the person who provided help	
Parent or parent-in-law	48.1 (281)
Spouse	25.3 (148)
Daughter or son	10.6 (62)
Grandparent	4.8 (28)
Other relative	9.4 (55)
Non-relative	1.7 (10)
Payment was required for help	
Yes	0.9 (5)
No	99.1 (579)
Length of time during which help was received	
Less than one week	18.2 (106)
One week to less than two weeks	23.7 (138)
Two weeks to less than one month	28.5 (166)
One month to less than six months	26.8 (156)
Six months or more	2.9 (17)

* Smaller sample sizes are due to missing data

Table 15. Relationship to the helper among injured individuals who received help for the injury in the rural IM-DSS sample (n=604)

	Relationship of helper to injured Row % (No.)		
By age group among all injured (n=604)			
	Parent or parent-in-law	**Spouse**	**Other**
Under 5	89.6 (60)	0 (0)	10.4 (7)
5 to <15	82.5 (146)	0 (0)	17.5 (31)
15 to <30	62.4 (78)	17.6 (22)	20 (25)
30 to <45	2.9 (3)	71.4 (75)	25.7 (27)
45 to <60	10.7 (8)	44 (33)	45.3 (34)
Over 60	1.8 (1)	34.5 (19)	63.6 (35)
By sex among heads of households (n=193)			
Male	4.7 (7)	76.7 (115)	18.7 (28)
Female	4.7 (2)	9.3 (4)	86 (37)
Among wives of household heads (n=59)			
	Daughter or son	**Spouse**	**Other relative**
	42.4 (25)	40.7 (24)	16.9 (10)

Table 16. Odds ratios for receiving help to cope with an injury by sociodemographic and injury-related characteristics, estimated from (n=640)

Variable	Odds ratio 95% CI p-value Model 1 (PCA-based) Unadjusted	Adjusted	Model 2 (Simple sum-based) Unadjusted	Adjusted
Sex				
Female	1.0	1.0	1.0	1.0
Male	1.24 (0.8, 1.91) 0.341	1.57 (0.79, 3.15) 0.2	1.24 (0.8, 1.91) 0.341	1.49 (0.74, 3.01) 0.264
Age group at the time of the injury				
Under 30	1.0	1.0	1.0	1.0
30 to <45	0.31 (0.15, 0.64) 0.001	0.78 (0.41, 1.49) 0.449	0.31 (0.15, 0.64) 0.001	0.77 (0.4, 1.48) 0.428
45 to <60	0.3 (0.15, 0.57) <0.0001	0.72 (0.32, 1.58) 0.409	0.3 (0.15, 0.57) <0.0001	0.73 (0.33, 1.65) 0.453
60 and older	0.32 (0.12, 0.82) 0.017	0.56 (0.15, 2.09) 0.389	0.32 (0.12, 0.82) 0.017	0.55 (0.16, 1.92) 0.349
Occupation				
Not earning an income	1.0	1.0	1.0	1.0
Shop/business or professional	0.19 (0.06, 0.56) 0.003	0.17 (0.06, 0.49) 0.001	0.19 (0.06, 0.56) 0.003	0.17 (0.05, 0.51) 0.002
Bodaboda/taxi	0.12 (0.05, 0.27) <0.0001	0.06 (0.02, 0.17) <0.0001	0.12 (0.05, 0.27) <0.0001	0.07 (0.02, 0.19) <0.0001
Farmer/agriculture	0.22 (0.09, 0.56) 0.001	0.24 (0.07, 0.79) 0.018	0.22 (0.09, 0.56) 0.001	0.23 (0.07, 0.75) 0.015
Vendor, laborer, construction, and mechanical work	0.21 (0.09, 0.52)	0.19 (0.07, 0.47)	0.21 (0.09, 0.52)	0.19 (0.07, 0.51)

Variable	Model 1 (PCA-based) Unadjusted	Model 1 (PCA-based) Adjusted	Model 2 (Simple sum-based) Unadjusted	Model 2 (Simple sum-based) Adjusted
	Odds ratio 95% CI p-value			
	0.001	<0.0001	0.001	0.001
Household head occupation				
Professionals or shop/business	1.0	1.0	1.0	1.0
Bodaboda/taxi drivers or mechanical work	1.56 (0.6, 4.05) 0.361	2.42 (0.86, 6.78) 0.094	1.57 (0.61, 4.07) 0.353	2.44 (0.89, 6.69) 0.083
Farmer/agriculture	1.39 (0.66, 2.9) 0.383	1.24 (0.47, 3.31) 0.665	1.37 (0.66, 2.87) 0.398	1.29 (0.53, 3.15) 0.579
Vender, laborer, or other	1.47 (0.78, 2.79) 0.238	1.62 (0.71, 3.69) 0.253	1.42 (0.74, 2.71) 0.286	1.61 (0.71, 3.69) 0.257
Wealth quintile				
Highest	1.0	1.0	1.0	1.0
Second highest	1.74 (0.67, 4.48) 0.252	1.81 (0.58, 5.64) 0.305	2.62 (1.09, 6.3) 0.031	2.6 (0.99, 6.82) 0.053
Middle	1.59 (0.61, 4.14) 0.346	1.62 (0.58, 4.5) 0.358	1.58 (0.58, 4.29) 0.371	1.37 (0.46, 4.05) 0.57
Second lowest	1.28 (0.54, 3.05) 0.574	1.64 (0.5, 5.34) 0.413	1.36 (0.58, 3.22) 0.48	1.46 (0.48, 4.46) 0.505
Lowest	1.55 (0.53, 4.52) 0.424	1.91 (0.57, 6.4) 0.294	1.65 (0.64, 4.25) 0.304	2.24 (0.76, 6.63) 0.144
Household head sex				
Male	1.0	1.0	1.0	1.0
Female	1.01 (0.6, 1.73) 0.958	1.3 (0.66, 2.54) 0.445	1.03 (0.61, 1.74) 0.923	1.28 (0.66, 2.49) 0.468

Variable	Odds ratio 95% CI p-value Model 1 (PCA-based) Unadjusted	 Adjusted	 Model 2 (Simple sum-based) Unadjusted	 Adjusted
Type of injury				
Unintentional fall	1.0	1.0	1.0	1.0
Road traffic injury	0.7 (0.39, 1.27) 0.238	1.24 (0.58, 2.63) 0.578	0.7 (0.39, 1.27) 0.238	1.23 (0.58, 2.61) 0.584
Other	1.19 (0.57, 2.48) 0.652	1.25 (0.63, 2.47) 0.53	1.19 (0.57, 2.48) 0.652	1.24 (0.61, 2.49) 0.552
Months elapsed since injury				
Less than six	1.0	1.0	1.0	1.0
Six to <12	1.73 (0.75, 3.99) 0.199	1.38 (0.54, 3.54) 0.506	1.73 (0.75, 3.99) 0.199	1.38 (0.53, 3.59) 0.512
12 to <24	1.31 (0.67, 2.57) 0.422	1.2 (0.56, 2.58) 0.634	1.31 (0.67, 2.57) 0.422	1.19 (0.55, 2.56) 0.653
24 to 36	1.68 (0.79, 3.55) 0.176	1.42 (0.69, 2.93) 0.338	1.68 (0.79, 3.55) 0.176	1.49 (0.7, 3.16) 0.302
Number of days respondent was unable to resume usual activities				
One to six	1.0	1.0	1.0	1.0
>Six	3.24 (1.72, 6.11) <0.0001	3.57 (1.86, 6.85) <0.0001	3.24 (1.72, 6.11) <0.0001	3.7 (2, 6.86) <0.0001
Cost of first time care including transport (USD)				
Less than two	1.0	1.0	1.0	1.0
>2 to 4	1.03 (0.44, 2.4) 0.945	0.81 (0.33, 2.02) 0.653	1.01 (0.44, 2.33) 0.984	0.77 (0.31, 1.9) 0.574
>4	1.34	1.31	1.3	1.2

Variable	Odds ratio 95% CI p-value			
	Model 1 (PCA-based)		Model 2 (Simple sum-based)	
	Unadjusted	Adjusted	Unadjusted	Adjusted
	(0.68, 2.66) 0.395	(0.65, 2.61) 0.449	(0.66, 2.59) 0.45	(0.59, 2.42) 0.611

Table 17. Financial coping strategies identified as being important (n=643)

	Column % (No.)
Total number of financial coping methods employed, out of a maximum of three	
None	1.6 (10)
One	38.3 (246)
Two	46 (296)
Three	14.2 (91)
	Row % of Total Sample (No.)
Financial coping methods identified as being one of the top three most important methods	
Received unconditional help from relatives and friends	75.6 (486)
Relied on savings	52.1 (335)
Got a loan	6.8 (44)
Sold household assets (agricultural or non-agricultural)	9.8 (63)
Sold animal stock	9.6 (62)
Changed gardening/farming practices	5.3 (34)
Unconditional help provided by the government	5.1 (33)
Changed dietary patterns involuntarily	2.3 (15)
Household member(s) took on more farm wage employment	2.2 (14)
Rented land/building	0.9 (6)
Sold land or building	0.8 (5)
Household member(s) took on more non-farm employment	0.8 (5)
Household member(s) left or joined the household	0.5 (3)
	Column % (No.)
Financial coping method identified as being the first most important method	

Received unconditional help from relatives and friends	60.8 (391)
Relied on savings	25.3 (163)
Sold household assets	3 (19)
Received unconditional help from the government	2.3 (15)
Received a loan	2.2 (14)
Other	6.4 (41)

Table 18. Model 1 (including PCA-based assets measure of wealth) adjusted relative risk ratios for most important financial coping mechanisms by sociodemographic characteristics using multinomial logistic regression (n=643)

	Relative Risk Ratio (95% CI) p-value		
	Receiving help from relatives and friends vs. Other	Relying on savings vs. Other	Receiving help vs. Relying on savings
Sex			
Female	1.0	1.0	1.0
Male	0.85 (0.49, 1.48) 0.566	1.09 (0.55, 2.18) 0.805	0.78 (0.5, 1.21) 0.269
Age group at the time of the injury			
Under 15	1.0	1.0	1.0
15 to <30	0.61 (0.36, 1.02) 0.06	1.64 (0.67, 4.03) 0.283	0.37 (0.18, 0.75) 0.006
30 to <45	0.85 (0.33, 2.17) 0.727	7.21 (2.31, 22.47) 0.001	0.12 (0.07, 0.21) <0.001
Over 45	0.59 (0.32, 1.09) 0.094	2.32 (0.98, 5.5) 0.057	0.25 (0.12, 0.52) <0.0001
Household head occupation			
Professional or shop/business	1.0	1.0	1.0
Bodaboda/taxi driver or mechanical worker	1.05 (0.4, 2.78) 0.916	0.9 (0.27, 2.97) 0.862	1.17 (0.54, 2.55) 0.69
Farmer/agriculture	0.93 (0.39, 2.24) 0.876	0.41 (0.14, 1.14) 0.088	2.29 (1.29, 4.07) 0.005
Market vendor, laborer, or other	0.86 (0.37, 1.97) 0.718	0.61 (0.24, 1.54) 0.294	1.41 (0.8, 2.49) 0.235
PCA-based wealth quintile			
Highest	1.0	1.0	1.0
Second highest	0.68 (0.3, 1.53) 0.354	0.62 (0.25, 1.52) 0.295	1.1 (0.6, 2.04) 0.753
Middle	0.78 (0.29, 2.12) 0.625	0.67 (0.23, 1.94) 0.466	1.15 (0.59, 2.27) 0.677
Second lowest	0.51 (0.2, 1.28) 0.15	0.48 (0.17, 1.33) 0.157	1.06 (0.56, 2) 0.86
Lowest	0.59	0.47	1.26

	Relative Risk Ratio (95% CI) p-value		
	Receiving help from relatives and friends vs. Other	Relying on savings vs. Other	Receiving help vs. Relying on savings
	(0.19, 1.84) 0.366	(0.14, 1.6) 0.226	(0.62, 2.59) 0.524
Household head sex			
Male	1.0	1.0	1.0
Female	0.84 (0.43, 1.64) 0.607	0.76 (0.39, 1.47) 0.417	1.1 (0.6, 2.02) 0.753
Type of injury			
Unintentional fall	1.0	1.0	1.0
Road traffic injury	0.89 (0.46, 1.73) 0.73	0.87 (0.44, 1.71) 0.69	1.02 (0.62, 1.69) 0.938
Other	0.54 (0.32, 0.94) 0.028	0.52 (0.27, 0.99) 0.047	1.05 (0.59, 1.86) 0.875
Time elapsed since injury			
Less than six months	1.0	1.0	1.0
Six to 12 months	1.76 (0.84, 3.71) 0.135	1.08 (0.46, 2.54) 0.867	1.64 (0.78, 3.46) 0.194
12 to 24 months	2.1 (1.02, 4.31) 0.043	1.09 (0.48, 2.48) 0.843	1.93 (1.08, 3.45) 0.026
24 to 36 months	1.97 (0.87, 4.48) 0.104	1.13 (0.48, 2.7) 0.776	1.74 (1.05, 2.88) 0.031
Number of days respondent was unable to resume usual activities			
One to six	1.0	1.0	1.0
>Six	1.05 (0.55, 1.98) 0.888	0.54 (0.3, 0.96) 0.034	1.95 (1.15, 3.29) 0.013
Money spent on first time care (transport and care services)			
Less than two	1.0	1.0	1.0
>2 to 4	1.03 (0.54, 1.97) 0.932	1.34 (0.66, 2.71) 0.421	0.77 (0.47, 1.25) 0.291
>4	1.67 (0.92, 3.01) 0.091	1.42 (0.68, 2.98) 0.35	1.17 (0.72, 1.91) 0.527

Table 19. Model 2 (including simple sum of assets-based wealth) adjusted relative risk ratios for most important financial coping mechanisms by sociodemographic characteristics using multinomial logistic regression (n=643)

	Relative Risk Ratio (95% CI) p-value		
	Receiving help from relatives and friends vs. Other	Relying on savings vs. Other	Receiving help vs. Relying on savings
Sex			
Female	1.0	1.0	1.0
Male	0.86 (0.49, 1.5) 0.59	1.08 (0.54, 2.18) 0.827	0.79 (0.51, 1.24) 0.311
Age group at the time of the injury			
Under 15	1.0	1.0	1.0
15 to <30	0.57 (0.34, 0.95) 0.032	1.57 (0.63, 3.92) 0.331	0.36 (0.18, 0.74) 0.005
30 to <45	0.89 (0.35, 2.27) 0.815	7.57 (2.47, 23.24) <0.0001	0.12 (0.07, 0.21) <0.0001
Over 45	0.55 (0.3, 1) 0.05	2.17 (0.92, 5.13) 0.077	0.25 (0.12, 0.51) <0.0001
Household head occupation			
Professional or shop/business	1.0	1.0	1.0
Bodaboda/taxi driver or mechanical worker	1.12 (0.42, 2.97) 0.823	0.95 (0.29, 3.16) 0.935	1.17 (0.55, 2.49) 0.675
Farmer/agriculture	0.99 (0.4, 2.44) 0.99	0.42 (0.14, 1.21) 0.107	2.38 (1.32, 4.29) 0.004
Market vendor, laborer, or other	0.89 (0.39, 2.03) 0.791	0.62 (0.25, 1.57) 0.317	1.44 (0.81, 2.54) 0.212
Simple sum-based wealth quintile			
Highest	1.0	1.0	1.0
Second highest	0.71 (0.37, 1.37) 0.31	0.77 (0.33, 1.82) 0.55	0.93 (0.49, 1.77) 0.817
Middle	0.96 (0.4, 2.31) 0.933	0.82 (0.29, 2.35) 0.712	1.18 (0.56, 2.45) 0.666
Second lowest	0.34 (0.14, 0.82) 0.017	0.37 (0.15, 0.91) 0.03	0.92 (0.52, 1.61) 0.761

	Relative Risk Ratio (95% CI) p-value		
	Receiving help from relatives and friends vs. Other	Relying on savings vs. Other	Receiving help vs. Relying on savings
Lowest	0.7 (0.24, 2.09) 0.524	0.6 (0.18, 2.04) 0.415	1.17 (0.54, 2.52) 0.697
Household head sex			
Male	1.0	1.0	1.0
Female			
Type of injury			
Unintentional fall	1.0	1.0	1.0
Road traffic injury	0.88 (0.45, 1.73) 0.719	0.85 (0.43, 1.69) 0.651	1.03 (0.62, 1.74) 0.897
Other	0.51 (0.3, 0.88) 0.016	0.49 (0.26, 0.92) 0.028	1.06 (0.59, 1.89) 0.855
Time elapsed since injury			
Less than six months	1.0	1.0	1.0
Six to 12 months	1.74 (0.82, 3.69) 0.145	1.07 (0.46, 2.5) 0.872	1.63 (0.77, 3.42) 0.199
12 to 24 months	2.05 (1.02, 4.15) 0.045	1.06 (0.47, 2.38) 0.895	1.95 (1.09, 3.46) 0.024
24 to 36 months	1.95 (0.86, 4.4) 0.109	1.14 (0.49, 2.65) 0.768	1.71 (1.04, 2.82) 0.034
Number of days respondent was unable to resume usual activities			
One to six	1.0	1.0	1.0
>Six	1.06 (0.55, 2.02) 0.86	0.54 (0.3, 0.98) 0.041	1.96 (1.17, 3.28) 0.011
Money spent on first time care (transport and care services)			
Less than two	1.0	1.0	1.0
>2 to 4	0.99 (0.51, 1.91) 0.97	1.31 (0.63, 2.69) 0.469	0.76 (0.46, 1.24) 0.27
>4	1.63 (0.93, 2.84) 0.085	1.39 (0.68, 2.85) 0.365	1.17 (0.72, 1.9) 0.525

Table 20. Adjusted percent change in the probability of a financial coping method being the most important, based on adjusted elasticities from a multinomial logistic model

Variable	Adjusted percent change in probability of identifying the coping strategy as being the most important 95% CI p-value			
	Model 1 (PCA-based)		Model 2 (Simple sum-based)	
	Savings	Help	Savings	Help
Male compared to female	0.035 (-0.036, 0.106) 0.329	-0.046 (-0.121, 0.029) 0.23	0.033 (-0.039, 0.105) 0.373	-0.043 (-0.119, 0.033) 0.267
Age (in years) compared to under 15 years				
15 to <30	1.0	1.0	1.0	1.0
30 to <45	0.119 (0.023, 0.216) 0.016	-0.156 (-0.245, -0.068) 0.001	0.12 (0.022, 0.218) 0.016	-0.163 (-0.248, -0.077) <0.0001
45 to <60	0.373 (0.274, 0.473) <0.0001	-0.328 (-0.43, -0.226) <0.0001	0.373 (0.274, 0.473) <0.0001	-0.325 (-0.43, -0.22) <0.0001
60 and older	0.187 (0.088, 0.286) <0.0001	-0.213 (-0.319, -0.106) <0.0001	0.186 (0.088, 0.284) <0.0001	-0.219 (-0.322, -0.117) <0.0001
Household head occupation compared to professionals or shop/business				
Bodaboda/taxi drivers or mechanical work	-0.028 (-0.177, 0.12) 0.709	0.028 (-0.113, 0.169) 0.696	-0.027 (-0.173, 0.119) 0.718	0.032 (-0.103, 0.168) 0.641
Farmer/agriculture	-0.142 (-0.249, -0.036) 0.009	0.108 (0.008, 0.209) 0.034	-0.147 (-0.257, -0.036) 0.009	0.118 (0.015, 0.221) 0.024
Vender, laborer, or other	-0.069 (-0.175, 0.038) 0.207	0.04 (-0.072, 0.152) 0.485	-0.071 (-0.179, 0.038) 0.2	0.046 (-0.066, 0.157) 0.423
Wealth quintile				
Highest	1.0	1.0	1.0	1.0
Second highest	-0.027 (-0.126, 0.072) 0.589	-0.014 (-0.128, 0.1) 0.812	0.003 (-0.103, 0.11) 0.949	-0.034 (-0.141, 0.073) 0.529
Middle	-0.03 (-0.138, 0.077) 0.579	0.002 (-0.128, 0.133) 0.97	-0.027 (-0.143, 0.089) 0.645	0.02 (-0.103, 0.143) 0.748
Second lowest	-0.031 (-0.133, 0.071) 0.551	-0.047 (-0.172, 0.078) 0.463	-0.024 (-0.111, 0.062) 0.579	-0.109 (-0.229, 0.011) 0.076
Lowest	-0.053 (-0.164, 0.058) 0.352	-0.01 (-0.156, 0.135) 0.889	-0.034 (-0.153, 0.085) 0.575	-0.005 (-0.147, 0.136) 0.939
Female household head compared to male	-0.021 (-0.109, 0.066) 0.635	-0.003 (-0.12, 0.114) 0.961	-0.021 (-0.111, 0.07) 0.655	0.003 (-0.112, 0.119) 0.956
Type of injury compared to unintentional fall				
Road traffic injury	-0.007	-0.006	-0.009	-0.004

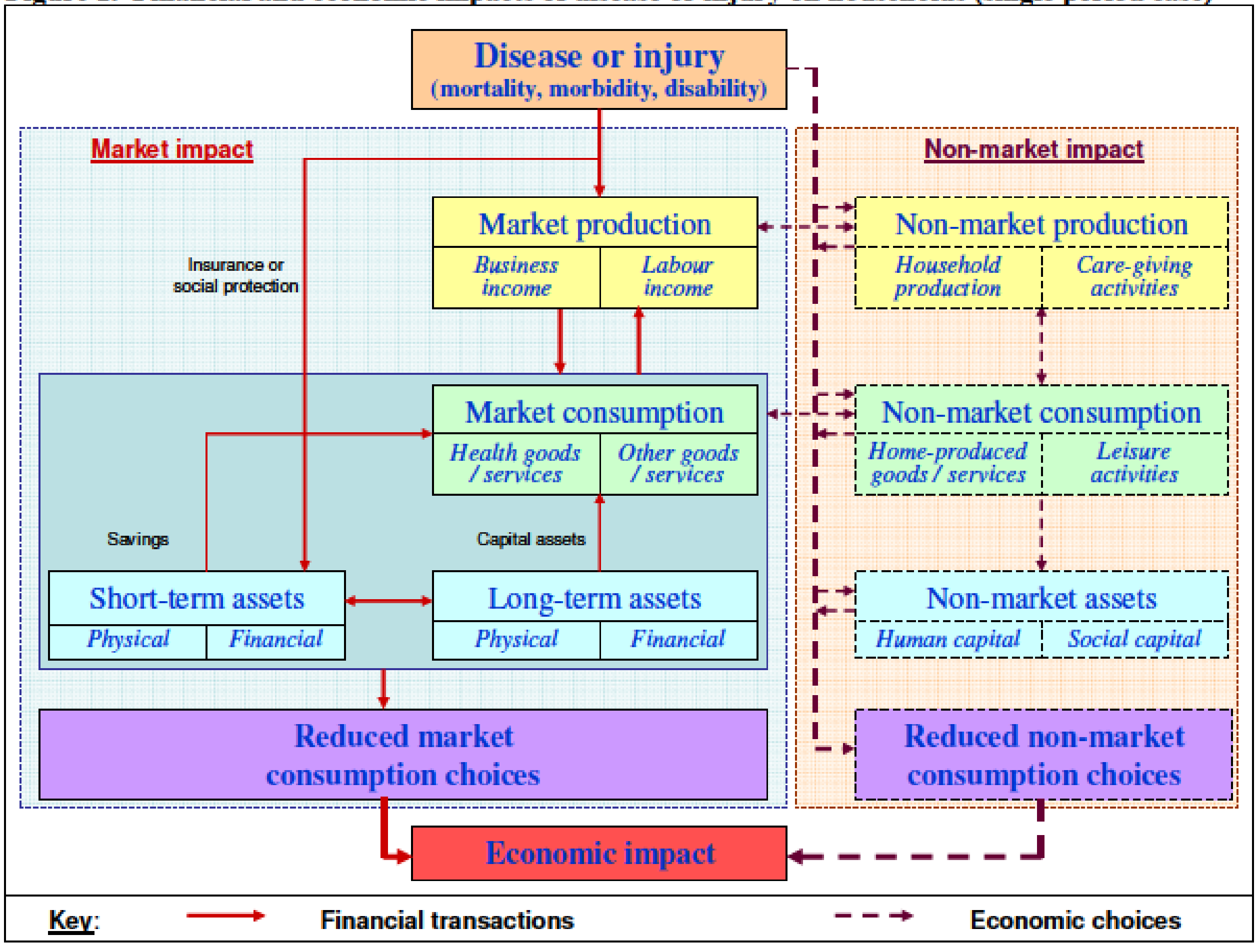
Variable	Adjusted percent change in probability of identifying the coping strategy as being the most important 95% CI p-value			
	Model 1 (PCA-based)		Model 2 (Simple sum-based)	
	Savings	Help	Savings	Help
	(-0.085, 0.072) 0.87	(-0.105, 0.093) 0.908	(-0.09, 0.072) 0.827	(-0.104, 0.096) 0.936
Other	-0.027 (-0.116, 0.061) 0.541	-0.047 (-0.146, 0.051) 0.348	-0.031 (-0.12, 0.058) 0.498	-0.051 (-0.15, 0.049) 0.32
Number of months elapsed since injury compared to less than six				
Six to <12	-0.063 (-0.182, 0.056) 0.299	0.117 (-0.019, 0.254) 0.093	-0.062 (-0.181, 0.056) 0.3	0.114 (-0.022, 0.251) 0.1
12 to <24	-0.084 (-0.179, 0.011) 0.082	0.153 (0.046, 0.259) 0.005	-0.086 (-0.179, 0.007) 0.07	0.151 (0.047, 0.255) 0.004
24 to 36	-0.069 (-0.155, 0.016) 0.113	0.134 (0.027, 0.242) 0.014	-0.068 (-0.152, 0.016) 0.115	0.13 (0.023, 0.236) 0.017
Unable to resume usual activities for more than six days compared to one to six days				
>Six	-0.114 (-0.201, -0.027) 0.011	0.097 (-0.012, 0.206) 0.082	-0.115 (-0.201, -0.028) 0.009	0.099 (-0.009, 0.206) 0.072
Cost of first time care including transport (USD) compared to less than two				
>2 to 4	0.045 (-0.034, 0.125) 0.265	-0.032 (-0.127, 0.063) 0.507	0.047 (-0.035, 0.129) 0.261	-0.038 (-0.134, 0.058) 0.435
>4	-0.01 (-0.089, 0.069) 0.799	0.062 (-0.018, 0.143) 0.13	-0.011 (-0.09, 0.068) 0.785	0.06 (-0.018, 0.138) 0.133

Table 21. Literature on household socioeconomic consequences of and responses to injuries in rural regions of low- and middle-income countries

Study	Region	Cause of Injury	Socioeconomic Consequences
Juillard et al. 2010	Nigeria, seven states where 40% live in rural areas	Road traffic	• Average cost of formal treatment was 35 USD. • 6 out of 36 employed individuals lost their jobs. • 44% lost between one and seven days, 36% lost between one and four weeks, and 20% lost over a month of work • 31 out of 35 individuals reported a reduction in earnings as a result of disability
Mock et al. 2003	Ghana, four rural districts	Blunt, penetrating, or burn	• 3% of households reported a loss of income • 33% of households reported a decline in food consumption and • 28% of households reported a decline • No effect on household income or food consumption • The most commonly reported coping strategies were intra-family labor reallocation (90%), borrowing money (24%), and sold but did not pawn belongings (2.5%) • Intra-family labor reallocation was utilized by 93% of households located on unpaved roads and 83% of those on paved roads. the chi square test found this relationship significant.
Nguyen et al. 2012	Individuals admitted to Thai Binh General Hospital in Vietnam	All causes	• Average total (direct and indirect) cost of injury was 365 USD • 26% came from households that experienced catastrophic expenditure following an injury. • Risk of catastrophic expenditure was higher among those who had more severe injuries, were of older age, and had a lower income

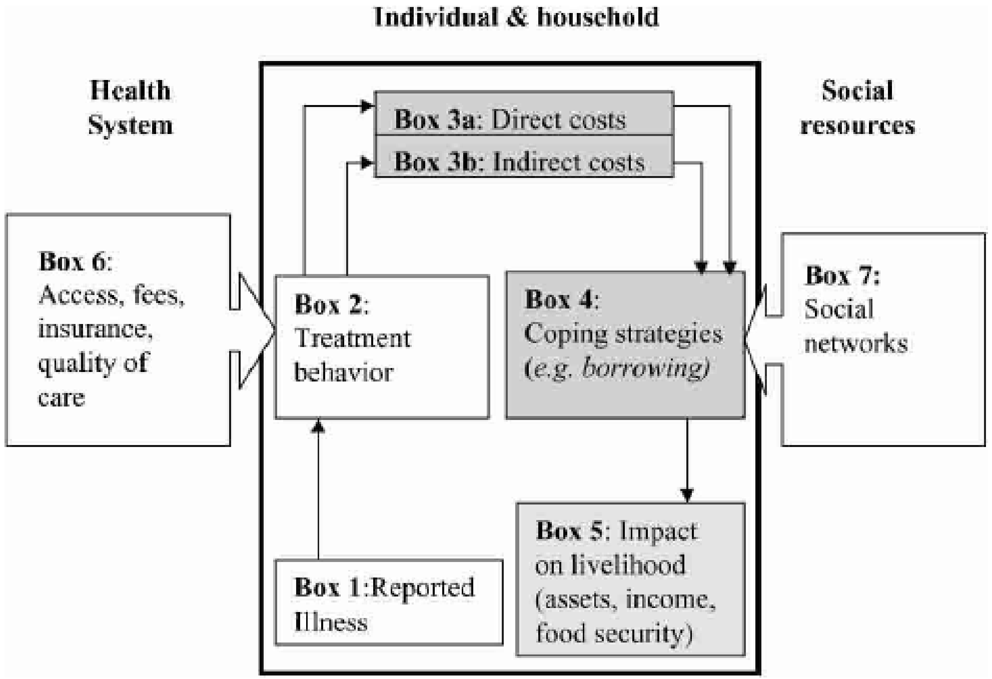
* Measured by degree of remoteness based on transportation access of the village

Figure 1. Financial and economic impacts of disease or injury on households (single period case)



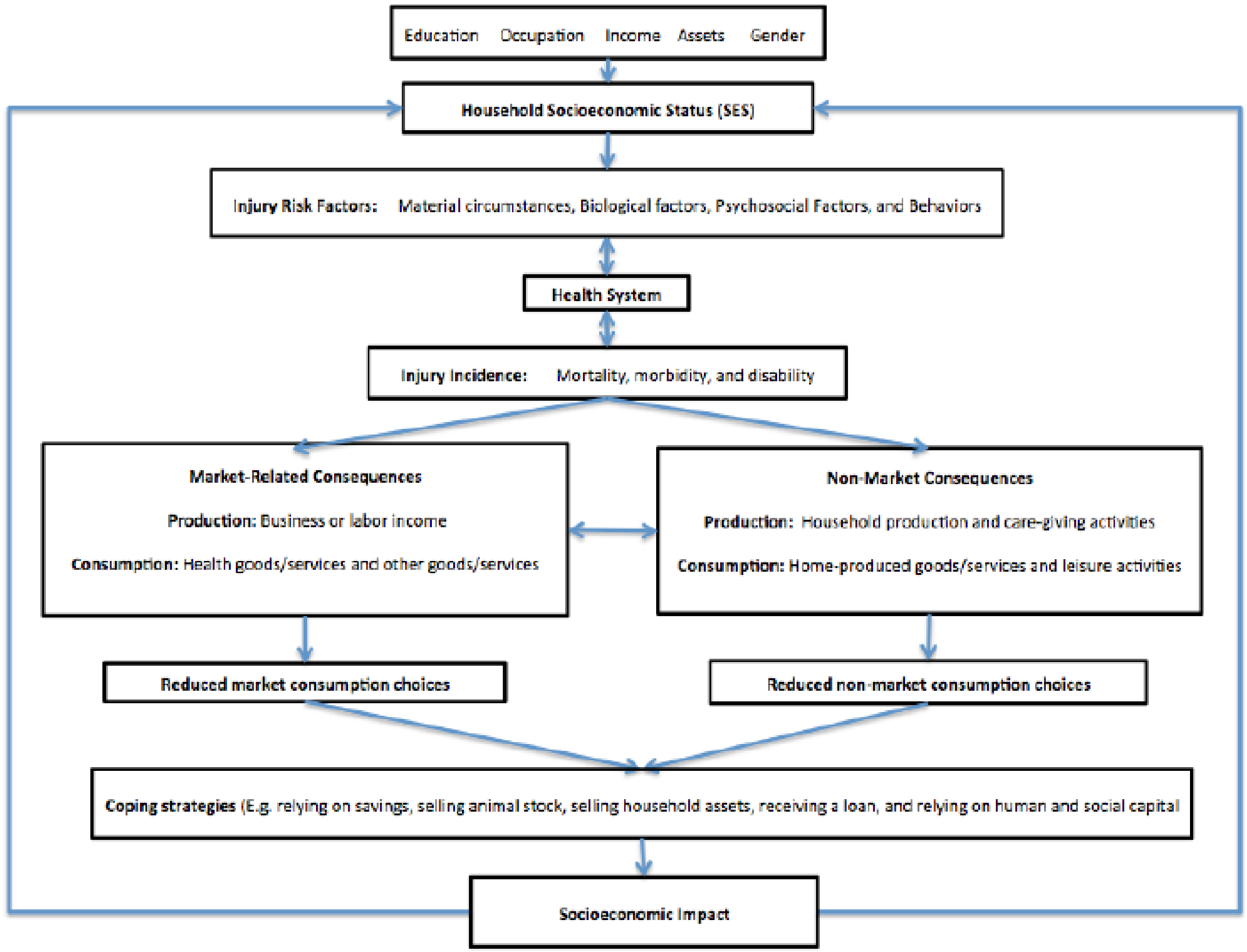
Source: WHO Guide to Identifying the Economic Consequences of Disease and Injury. Gevena, Switzerlind: Department of Health Systems Financing, Health Systems and Services, World Health Organization, 2009.

Figure 2. Conceptual framework for analyzing the economic burden of illness for households



Source: Russell S. The economic burden of illness for households in developing countries: a review of studies focusing on malaria, tuberculosis, and human immunodeficiency virus/acquired immunodeficiency syndrome. *Am J Trop Med Hyg* 2004; **71**(2 suppl): 147-5

Figure 3. Conceptual Framework For Research



Source: Author

Figure 4. Map of Uganda, showing the Iganga-Mayuge-Demographic Surveillance Site within the Iganga and Mayuge Districts

Figure 5. Frequency of raw total household asset count in the rural IM-DSS (n=7,355)

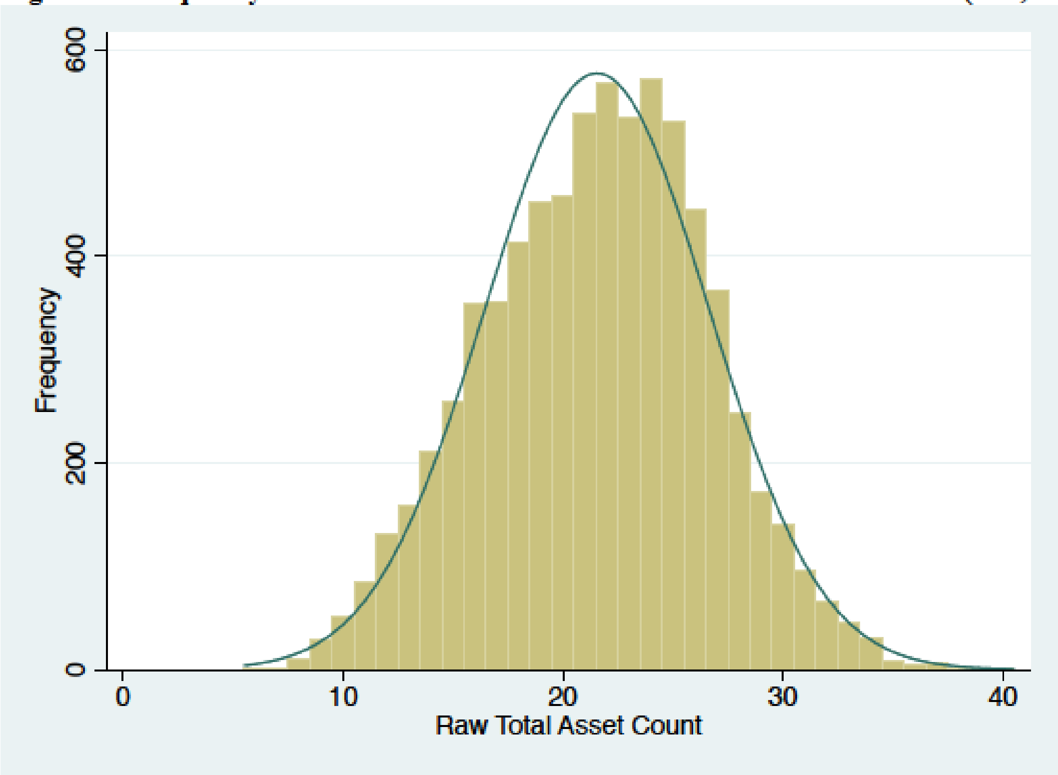


Figure 6. Percentage of Variance Explained by the Principal Components

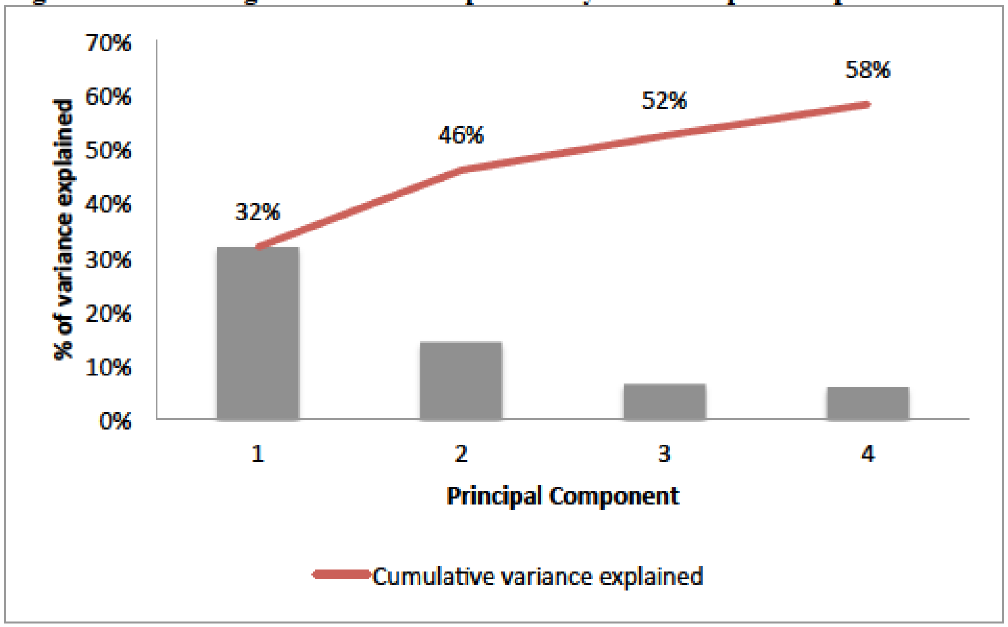


Figure 7. Percentage of variance explained by the firs four principal components of the Pearson correlation PCA-based asset index

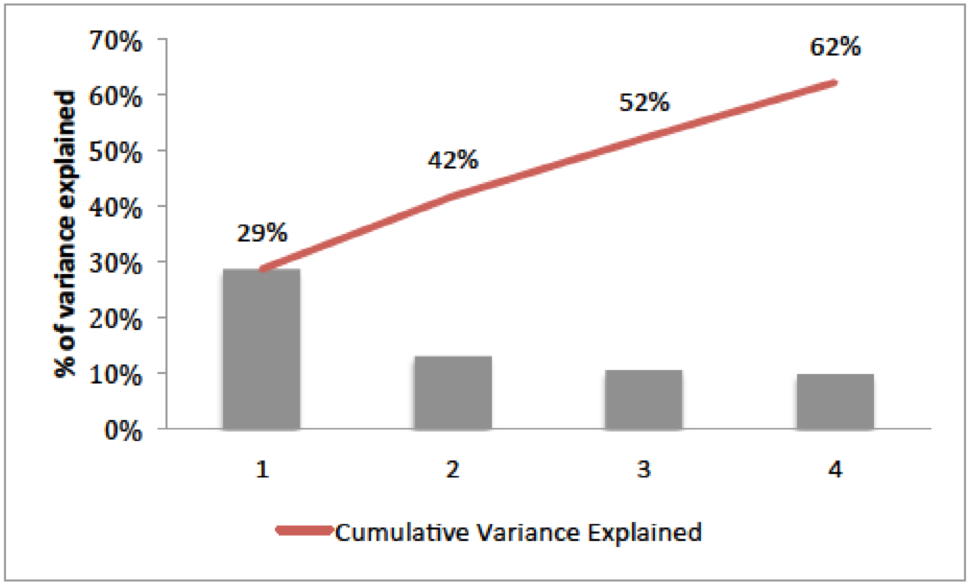


Figure 8. Frequency of simple sum of assets index score in the rural IM-DSS (n=7,355)

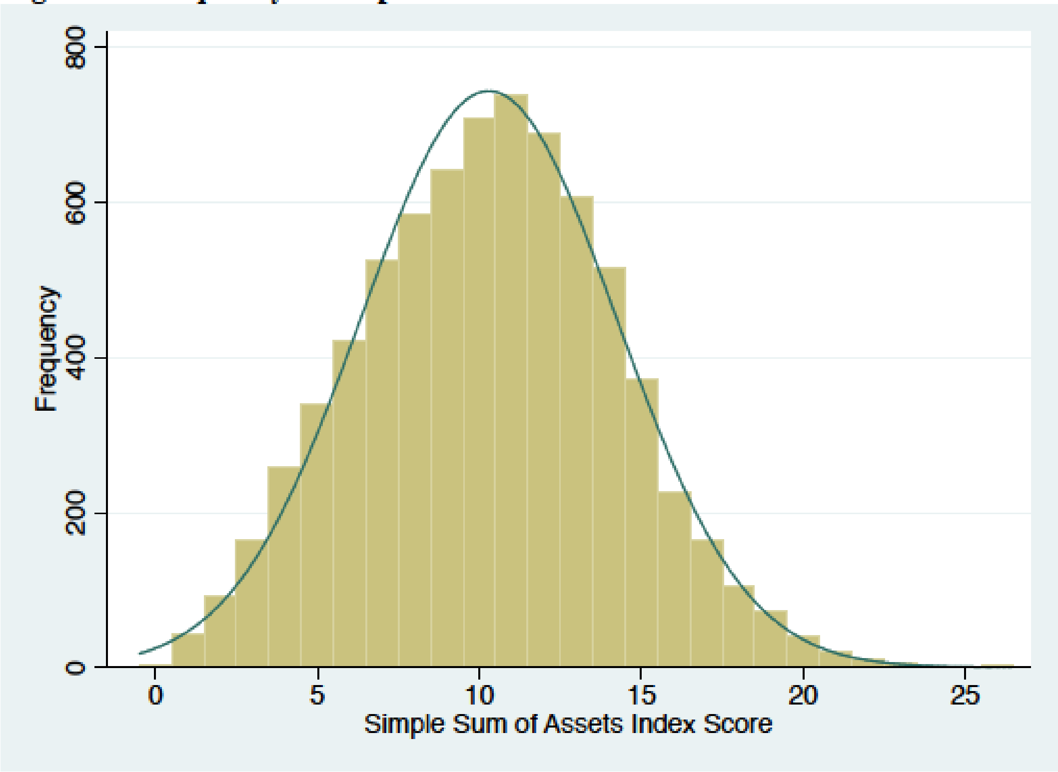
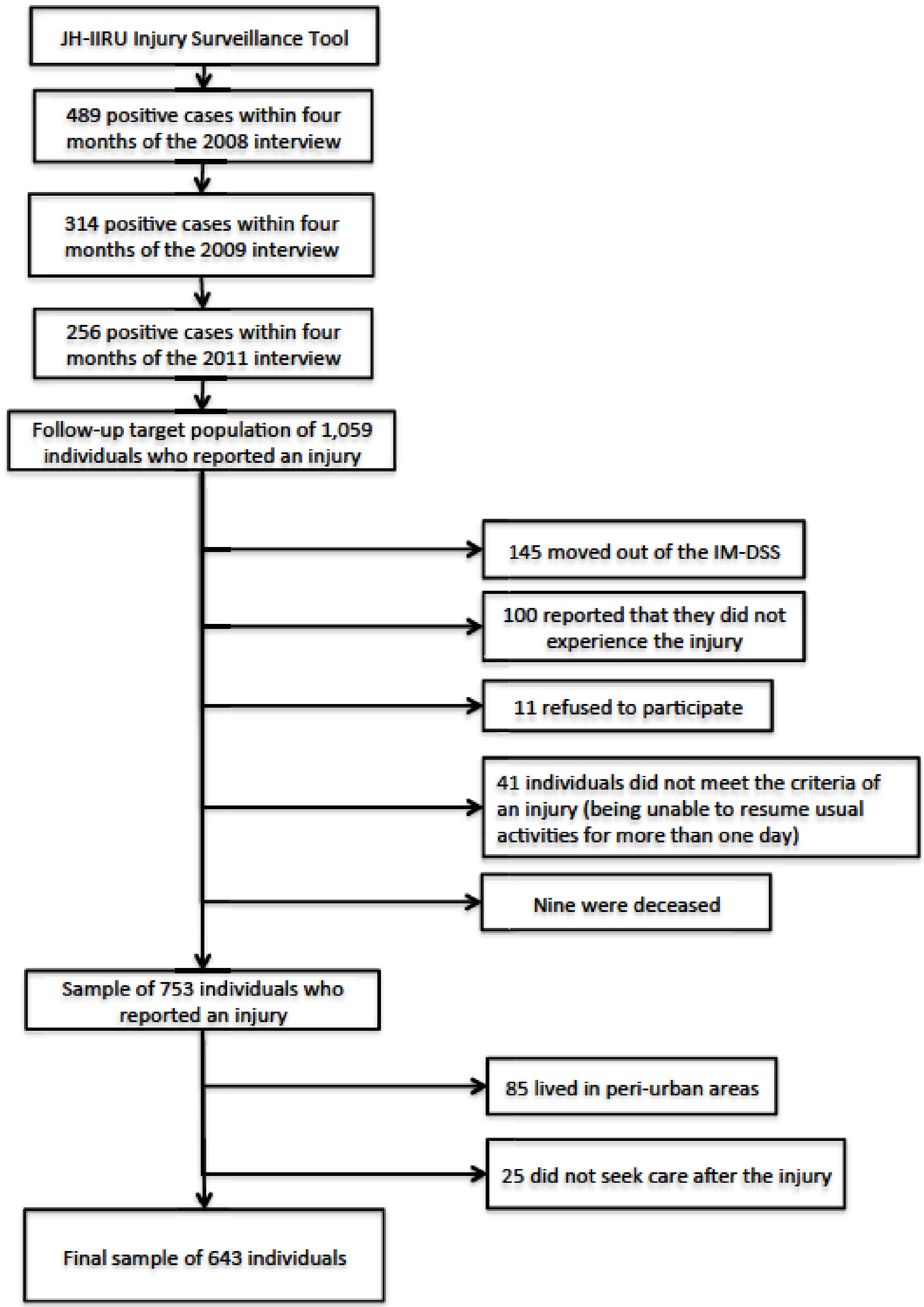


Figure 9. Study Flow Chart of Sample Selection



Conclusions and Implications

Summary of Key Findings

Achieving a deeper understanding of the role that SES plays in generating injury disparities as well as the socioeconomic consequences experienced by the injured and their households will inform policy and planning and strengthen the argument for injury prevention and treatment. The three papers *Socioeconomic Status and Injuries in Uganda: Disparities in a Demographic Surveillance Site, Direct Socioeconomic Consequences of Injuries in a Demographic Surveillance Site*, and *Household Socioeconomic Consequences of Injuries in a Demographic Surveillance Site* present policy-relevant findings, provide motivation for future research, and contribute to the growing literature on the socioeconomic disparities and consequences of injuries

Socioeconomic Status and Injuries in Uganda: Disparities in a Demographic Surveillance Site

This study utilizes cross-sectional data from the Iganga and Mayuge Demographic Surveillance System (IM-DSS) and a Johns Hopkins University International Injury Research Unit (JH-IIRU) injury surveillance tool that detected injuries that occurred within a four month period in 2009 and 2010. Among the 59,248 individuals who lived in the rural IM-DSS during February—April 2009 and/or March—May 2010, the rural injury rate was 20.7 injuries per 1,000 person-years and the RTI incidence rate in the rural IM-DSS was 8.8 per 1,000 person-years. Men were more susceptible to injuries, as their incidence rate was twice that observed among women, and being male significantly increased the odds of experiencing an injury. Having a male household head offered protection, and this association may be related to the finding that most of the female household heads did not have a partner and were thus at a social and economic disadvantage. Household wealth did not affect one's risk of experiencing an injury or RTI, but one exception was that when wealth was measured as a simple sum of assets (as opposed to an asset index built from principal components analysis), one association showed that the second highest group was at greater odds of an all-causes injury. The general lack of an association between wealth and injuries suggests that privilege, power, and resources can not offer protection when current interventions and advances in injury prevention in rural Uganda are grossly insufficient.

Direct Socioeconomic Consequences of Injuries in a Demographic Surveillance Site

This cross-sectional study followed up on all individuals who reported an injury according to the injury surveillance tool implemented at the Iganga and Mayuge Demographic Surveillance System (IM-DSS) and conducted in-depth household-based interviews about the direct socioeconomic consequences of the injured's most recent injury. Among the 643 injured individuals in the study sample, most reached the site of initial care within an hour and an average of 0.5 USD was spent on transportation. The cost of the initial care amounted to an average of seven dollars. Among the employed, only 10% were unable to return to his or her occupation following the injury, and among the majority who were able to return to their jobs, the average number of missed work days was 31. The length of time spent in functional impairment due to the injury was strongly and positively associated with cost of transportation, cost of care, job loss, number of work days lost, and number of school days lost. None of the seven socioeconomic consequences had a significant relationship with household wealth, but this finding does not exclude the possibility that injuries impose a regressive relative cost burden on patients.

Compared to patients who traveled to initial care by motorcycle, those who used a four-wheel motor vehicle lost a significantly greater amount of time and money, while traveling by foot or bicycle significantly decreased these measures, indicating that those who traveled by the slowest modes of transportation were not traveling a very far distance. Rather than receiving care from a traditional healer, choosing to seek care from a private clinic or from a public hospital led to a significantly greater cost of care. But those individuals who went to traditional healers had significantly longer periods of time spent in functional limitation compared to those who went to private clinics and even drug stores or pharmacies. Finally, three demographic characteristics seemed to exacerbate the direct negative consequences of injury: those who were 45 years of age or older spent longer period of time travelling to initial care, males spent more money on initial injury care, and injured children from female-led households experienced less missed school days than did children from male-led households.

Household Socioeconomic Consequences of Injuries in a Demographic Surveillance Site

This cross-sectional study followed up on all individuals who reported an injury according to an injury surveillance tool and conducted in-depth household-based interviews about the household socioeconomic consequences of the injured's most recent injury. Among the 643 injured individuals in the study sample, the three major household socioeconomic consequences, in order of increasing frequency, were a decrease in food purchases, a decline in food production, and a decrease in income. In response to the injured individual's difficulty with resuming usual activities, the experience of receiving help was common to 87% of the injured's households. The most common type of assistance entailed the provision of necessity goods such as food or clothing, and the majority of the helpers were members from the same household. In identifying which coping strategies were most important to the household, respondents most frequently cited unconditional help from family and friends, followed by relying on savings, and then selling animal stock.

For the outcomes of a decline in income, food production, and food purchasing, as well as receiving help due to difficulty with the injury, the impact of functional impairment is evident and expected. Cost of transportation to initial care and cost of care predicted a decline in household income, food production, and food purchasing, and belonging to poorer household groups significantly impacted the reporting of a decline in household income and food production. Wealth did not predict the likelihood of receiving help for the injured's difficulty with resuming usual activities nor did it significantly influence the selection of the most important coping method. Having an occupation in agriculture or farming unsurprisingly puts the injured's household at greater risk for a decline in household food production due to the injury. While length of recall time was a concern in this study which included a wide spectrum of months passed since the most recent injury, the variable did not significantly affect any of the household socioeconomic outcomes.

Implications for Action

This study yields new information for the purpose of aiding in the development of public health policies, programs, and interventions to meet the needs of individuals at risk of injuries in rural Uganda or similar sub-Saharan African countries. The IM-DSS was established with a goal of generating information to support evidence-based decisions and policy making in the Iganga and Mayuge districts but also at a national level. That the site is housed within the Iganga District Health Office (DHO) only strengthens the relationships between researchers and policy makers and the hope to fulfill the IM-DSS' goal to share valuable knowledge and inform policy decisions made at the DHO and the Uganda Ministry of Health.

This study first suggests that calls for the Ugandan government, including the local Iganga District Health Office, to demonstrate commitment in injury prevention through the following recommendations:

- Improve road infrastructure which includes more paved roads, physical separation of pedestrians and bicyclists from motorized transport through the provision of walkways, traffic signals at junctions, safe and raised pedestrian crossings, speed bumps or rumble strips, median barriers to prevent overtaking and to eliminate head-on crashes, better highlighting of road hazards, advisory speed limits at sharp bends, and systematic removal of roadside hazards such as trees.

- Change traffic legislation and manage regulation to ensure the control of speed and drunk-driving, mandatory use of motorcycle helmets, mandatory use of seat belts and child restraints, and a compulsory law for the use of daytime running motorcycle headlights.
- Invest in a mass transit system to ensure safer modes of road travel.
- Target injury prevention among males (particularly RTIs), individuals belonging to female headed households, middle aged adults and adults over 60 years of age.

This study also urges the government to improve the health system through the following actions:

- Develop a formal pre-hospital emergency system or implement pre-hospital trauma care program for lay first-responders.
- Invest in injury treatment and rehabilitation including community-based rehabilitation (CBR), physiotherapy, increased access to surgery, rehabilitation centers or hostels, orthopedic appliance workshops, and a transportation system for patients.
- Identify ways in which the public and private sectors can combine efforts to increase access to and improve quality of health care.
- Implement and explore pro-poor financing mechanisms including micro insurance schemes targeting the poor, voucher systems, a national health insurance scheme that is specifically pro-poor, and subsidizing to enable the private sector to ensure fair and affordable pricing

- Provide incentives to formal financial institutions to increase, improve, and bring their services to rural households and provide education and training on savings

Another set of actions proposed by this study calls for the involvement of the private and not-for-profit sector organizations working to improve community health, development, and empowerment:

- Implement a farming education and training program that covers the expected topics of improving food production and farm techniques but also integrates injury prevention and education. To protect one's household from the negative impacts of a health event such as an injury, the program would promote greater flexibility in sex- and age-specific labor roles, non-labor intensive crops, and systems that decrease vulnerability to ecological factors (e.g. genetic resources for drought resistance).
- Build microfinance opportunities and services to extend financial services, specifically the mobilization of savings, to rural households

Future Research

In addition to contributing to the growing literature on socioeconomic disparities and consequences of injuries, this study highlights a number of areas for future research.

First, as Uganda continues to witness and experience rapid urbanization and the distribution of injury risk factors shifts, regular injury surveillance is imperative, and such data can track how the relationship between injury and SES changes over time. And within rural areas, urbanization should be understood as a measure that is broader and more complicated than a dichotomous variable. Also, educational attainment and consumption were missing from this study, and future research must include it as a socioeconomic variables of interest.

To further explore the relationship between socioeconomic status (SES) and injuries, follow-up study should determine how injury risk factors vary by SES. The findings on the sex disparities should inspire future qualitative work that can capture the experiences and challenges of male injured individuals and female household heads and identify the effect modifiers of the relationship between sex and injury risk.

The findings on the direct socioeconomic consequences of injuries give impetus for gathering more detailed information such as total costs of care beyond the initial treatment, household consumption data and the household's capacity to pay for medical treatment so that relative costs of care can be calculated and the threshold for catastrophic expenditure can be explored. Future work should also apply values to the productivity time loss for the purpose of aggregating total direct costs of injury serves and contributing to cost-effectiveness analyses of interventions.

Third, a future study should have a longitudinal design with a group of non-injured persons presenting counterfactual levels of characteristics that may influence the likelihood of becoming injured. Such a study would capture a more precise effect of an injury on direct and household socioeconomic consequences, help identify the channels through which injury leads to the consequence and provide a more in-depth understanding of household coping strategies.

Fourth, the findings on household coping strategies add some important questions to the injury research agenda. To better design interventions, one should track how coping strategies change over time, examine the extent to which the strategies help households smooth consumption, stabilize and recover from direct and indirect injury costs, and identify ways in which these strategies may increase vulnerability to future adverse events or endanger long term household livelihood objectives.

Finally, this study has the unique feature of measuring the socioeconomic disparities and describing the socioeconomic consequences of injuries at a demographic surveillance site. The findings of such research should ultimately serve as a platform for a multi-country DSS-based investigation of the relationship between SES and injuries in LMICs.

Appendix 1. Disability and Injury Module

<u>Iganga-Mayuge Demographic Surveillance System</u>
<u>Injury and Disability Screening Module</u>

The next questions ask about injuries you or anyone in your household may have had, which prevented the victim from carrying out his/her normal daily activities for at least one day or for which you paid for any type of treatment.

1. Have you or any member of your household had any type of injury within the last four months?
   - 00 No
   - 01 Yes

2. If yes, what was the cause of injury?
   - 01 Traffic
   - 02 Pedestrian
   - 03 Occupant
   - 04 Cyclist
   - 05 Unintentional fall
   - 06 Burn
   - 07 Gun shot
   - 08 Stab
   - 09 Blunt injury
   - 10 Poisoning
   - 11 Drowning
   - 12 Dog, snake or other animal bite
   - 13 Landmine
   - 14 Other causes

Appendix 2. Relevant sections of in-depth injury follow-up Tool

GENERAL INJURY

I would like to ask you some questions about the most recent injury that you/[NAME OF DECEASED HOUSEHOLD MEMBER] have had, which prevented you/[NAME OF DECEASED HOUSEHOLD MEMBER]from carrying out your normal daily activities for at least one day or for which you paid for any treatment.

	QUESTIONS	RESPONSES							
01	When was your/[NAME OF HOUSEHOLD MEMBER'S] most recent injury? **Obukosefu ighe/ow'omumakaago kewali/yali wakafuna bwaligho li? **RECORD AS MUCH INFORMATION AS THE RESPONDENT CAN PROVIDE.**	D	D	M	M	Y	Y	Y	Y
02	How many times in the past year have you/[NAME OF HOUSEHOLD MEMBER] experienced this specific kind of injury? **Mirundi emeka mumwaka ogubise ighe/ow'omumakaago gyewafuna obukosefu obwekika nga kino?)	________ Don't know………………………………………… 98							

	QUESTION	RESPONSE		
03	What kind of injury was your/ [NAME OF HOUSEHOLD MEMBER'S] most recent injury? ** Bukosefu bwakika ki ighe/ ow'omumakaago bwewali wakafuna?	Road or traffic injury (driver, cyclist, occupant, pedestrian, etc) (Bukosefu bwaku luguudo oba bwabidukka (dereva, wakagaali, mwenemu, wabigere, n'ebindi)….	1	
		Intentional violence-related injury (obukosefu obwekuusa ku kavuyo akagenderere)	2	**IF ALIVE, SKIP TO Q26, PAGE 7**
		Poisoning (butwa)………………………………………	3	**IF ALIVE, SKIP TO Q34, page 8**
		Burns (Kw'okebwa)……………………………………	4	**IF ALIVE, SKIP TO Q42, page 10**
		Drowning or near drowning(okudimira oba, katono adimire)………………………………………….	5	**IF ALIVE, SKIP TO Q48, page 11**
		Dog, snake or animal bite (Kulumibwa mbwa,musota oba kisolo)………………………..	6	**IF ALIVE, SKIP TO Q53, page 12**
		Unintentional fall (Okugwa okutali kugenderere)……………………………………	7	**IF ALIVE, SKIP TO Q63, page**

	……….	13
	Landmine (Bbomu ey'omuitaka)………………… 8 Other (Specify) Ekindhi (Inhonhola)…………… 9	IF ALIVE, SKIP TO Q69, page 14

IMPORTANT! : IF INJURED INDIVIDUAL IS DECEASED → SKIP TO Q69, PAGE 14

CARE FOR THE INJURY

Now I would like to ask you some questions about care that you sought and received after your injury.
**Buti nandhienze okubuuzaaku ebibuzo kubwiidhandhabi bwewanonhia era wafunha nga ofunhe obukosefu.

	QUESTIONS	RESPONSES		
69	Did you/[HOUSEHOLD MEMBER] receive care at the scene where you were injured (right after you were injured)? **Ighe/(ow'omumaka) wafunha obwiidhandhabi mukifoekyo wewafunhira obukosefu (nga wakafunha obukosefu)?	Yes…………………………………………………	1	
		No…………………………………………………	2	SKIP TO Q73
		Don't know…………………………………………	98	
70	Who provided care for you/ [HOUSEHOLD MEMBER] at the scene of the injury? **Ani eyakuwa /(ow'omumaka) obwiidhandhabi mukifo wewa/weya funhira obukosefu)?	Relative (waluganda)………………………………	1	
		Good Samaritan (dmuzirakisa)…………………	2	
		Police/ Medic (musilikale/musawo)…………	3	
		Traditional healer(omusawo owekirugavu/ omuyigha)………………………………………	4	
		Someone involved in the injury (omuntu gwe twali naye mu kabendhe)…………………	5	
		Other (specify) ………………………………………	6	
		Don't know…………………………………………	98	
71	How long after the injury occurred did you/ [HOUSEHOLD MEMBER] receive care at the scene of the injury? **Wabita ibanga ki	Within six hours (musaawa mukaaga)………	1	
		Between six to twelve hours (ghagati wa saawa mukaaga n'eikumi n'ebiri)………………	2	

	ng'omaze okufuna obukosefu/ (ow' omumaka) nmale ofune obwiidhandhabi mu kifo akabendhe wekali?	Between 13 to 24 hours (ghagati wa saawa ikumi n'aisatu n'abiri n'einha)…………………	3	
		After a day or more (nga ghabise olunaku oba ibiri)……………………………………………… .	4	
		Don't know………………………………………………	98	
72	What type of direct care did you/[HOUSEHOLD MEMBER] receive at the scene of injury? **Bwidhandhabi kika kiighe/(ow'omumaka) bwewa/yafuna mukifo wewafunira/yafunira obukosefu? **MULTIPLE ANSWERS ALLOWED.**	First aid (obwiidhandhabi obusokelwaku)…	1	
		Control bleeding (okuziyiza omusaayi)…….	2	
		Other (specify) ………………………………………	3	
		Don't know………………………………………………	98	
73	Did you/[HOUSEHOLD MEMBER] seek care after the scene of the injury? **Ighe/(ow'omumaka) wajaaku okufuna obwiidhandhabi nga oviire wewafunira obukosefu?	Yes………………………………………………………	1	
		No………………………………………………………	2	**SKIP TO Q82**
		Don't know………………………………………………	98	
74	Now I am going to ask you questions about the time when you/[HOUSEHOLD MEMBER] first sought care after the scene of the injury. Where did you/[HOUSEHOLD MEMBER] go for care? **Buti nja kukubuuzaku ebibuzo ku kiseera ighe/(ow'omumaka) wewasoka okunonhia obwiidhandhabinga oviire mukifo wewafunhira obukosefu. Ighe(ow'omumaka) wajaagha okufuna obwidhandhabi?	Hospital (ilwaliroeinene)………………………..	1	
		Health center (mu ilwaliro eitono)……………	2	
		Private clinic(akalwaliro ak'omuntu)…………	3	
		Traditional practitioner (omusawo ow'ekirugavu) ………………………………………	4	
		Pharmacy/drug store (eiduuka elitunda obulezi obw'ekizungu)……………………………	5	
		Other (specify)………………………………………	6	
		Don't know………………………………………………	98	
75	Were you/[HOUSEHOLD MEMBER] admitted to the facility for treatment of	Yes………………………………………………………	1	
		No……………………………………………………………2		**SKIP**

	your/[HOUSEHOLD MEMBER's] injury? **Ighe/(ow'omumaka) wawebwa/ yawebwa ekitanda okwiidhandhabwa obukosefu?	…… Don't know…………………………………………	 9 8	TO Q77
76	For how long did you/[HOUSEHOLD MEMBER] stay in the facility for treatment of your injuries? **Wamala/ (ow'omumaka) yamala mu ilwaliro ibanga ki nga oidhandhabwa obukosefu?	______hours…………………… ……… ______days………………………….. ______months………………………… Don't know…………………………………………	 1 2 3 9 8	
77	How were you/[HOUSEHOLD MEMBER] transported to the place where you/[HOUSEHOLD MEMBER] received care? **Ighe/ (ow'omumaka) wa/yatwalibwa atya mukifo wewafunha obwiidhandhabi?	Personal vehicle (motoka yange)……………… Taxi (takisi)…………………………………………… Ambulance (byulensi)……………………………… Motorcycle (pikipiki)……………………………… Bicycle (Kagaali)…………………………………… Other (specify)……………………………………… Don't know…………………………………………	1 2 3 4 5 6 9 8	
78	How long did it take you/[HOUSEHOLD MEMBER] to get to the place where you received care? **Kyakutwalira ibanga ki ighe/(ow'omumaka) okutuuka mu kifo wewafunha obwiiidhandhabi?	Less than 1 hour (obutaswiika saawa ndala)………………………………………… ……… 1-2 hours (saawa ndala ku ibiri)……………….. 3-6 hours (saawa isatu ku mukaaga)………. 7-9 hours (saawa musanvu ku mwenda)….. 10-12 hours (saawa ikumi ku ikumi n'aibili) 13-24 hours (saawa ikumu naisatu ku abiri nainha)………………………………………… ………. More than one day (okuswiika olunaku)….. Don't know…………………………………………	1 2 3 4 5 6 7 9 8	

79	How much did it cost your household (in shillings) to transport you/[HOUSEHOLD MEMBER] to the place where you received care?**Kyakutwalira/ (ow'omumaka) sente imeka (mu silinghi) o'kuutambuza okutuuka wewafunhira obwiidhandhabi?	______________________ Don't know.. 98
80	For this first time when you/ [HOUSEHOLD MEMBER] sought care after the scene of the injury, how much did the care cost (in shillings)? **Ku mulundi guno ogw'asooka ighe/(ow'omumaka) okunonhia obwiidhandhabi nga oviire mukifo wewafunhira obukosefu, obwiidhandhabi bw'akutwalira sente imeka (mu silinghi)?	______________________ Don't know.. 98
81	After the first time you/ [HOUSEHOLD MEMBER] went to seek care, how many times did you/[HOUSEHOLD MEMBER] have to get care for your injury? **Nga oviire kumulundi ogw'asooka ighe (ow'omumaka) gwewajja okufunha obwiidhandhabi,mirundi emeka gyewali otekwa okufunha obwiidhandhabi ku bukosefu bwo?	__________ times, and still undergoing treatment.. .... 1 __________ times, and treatment is complete.. .... 2 Don't know.. 98
82	Did your injury require surgery? **Obukosefu bwo bwali bwetagisa okulongosebwa?	Yes.. .... 1 No.. .... 2 SKIP TO Q84 Don't know.. 98
83	Did you/[HOUSEHOLD MEMBER] receive surgery for your injury? **Wafunha	Yes.. .... 1 No.. 2

	okulongosebwa kubukosefu bwo?	……… Don't know……	9 8
84	Were you/[HOUSEHOLD MEMBER] able to resume usual activities within the first day of the injury? **Ighe (Ow'omumaka) wasobola okwiramu okukola emirimu dho edabulidho mwibanga ely'olunaku olulamba nga omaze okufuna obukosefu?	Yes………	1	SKIP TO Q86
		No, I was unable to resume usual activities for more than one day (tiyasobola kwiramu kukola milimu gye egyabulidho okuswiika olunaku olulala)……	2
		No, I am permanently unable to resume usual activities (tiyairiramu ilala kukola milimu gye egyabulidho)……	3	SKIP TO Q86
		Death (kufa)……	4
		Don't know……	9 8
85	For how long were you/ [HOUSEHOLD MEMBER] unable to resume usual activities? **Kyakutwalira ibanga ki ighe/(ow'omumaka) obutasobola kwiiramu kukola mirimu egyabuliidho?	Between one to six days (ghagati w'olunaku olulala ku mukaaga)……	1
		Between one to four weeks (ghagati w'esasira (wiiki) endala ku ina)……	2
		For more than one month (kuswiika omwezi mulala)……	3
		Don't know……	9 8
86	Did someone help you/ [HOUSEHOLD MEMBER] for your/[HOUSEHOLD MEMBER]'s difficulty due to the injury? **Eriyoku omuntu eyakuyambaku/ (ow'omumaka) olw'obukalubirivu obw'aletebwa obukosefu?	Yes………	1
		No………	2	SKIP TO Q95, page 18
		Don't know……	9 8
87	What is the name of the person who most often helped you/ [HOUSEHOLD MEMBER]? **Eriina ely'omuntu oyo atera okukuyamba/ (ow'omumaka) nhani?	__________ Don't know……	9 8
88	What was [NAME OF HELPER]'s	Spouse (musadha (bazze) wange/	

	relationship to you/[HOUSEHOLD MEMBER]? ** ---------omweta tya (ow'omumaka) amweta atya?	Mukazi wange…………………………………………………… Son/daughter (mutabani wange/muwala wange)…………………………………………………… Parent or parent-in-law (bazaire bange/ bakoirume bange)…………………………………… Grandparent (dhada wange)…………………… Grandchild (omwiidhukulu)…………………… Child-in-law (omwiiwa)…………………………… Other relative (ow'oluganda owundhi)……. Medical worker (wa byabulamu)……………… Community worker (omusawo ow'okukyaalo)………………………………………… Neighbor (mulilanwa)……………………………… Friend (ow'omukwano)…………………………… Paid/domestic help (omukozi ow'aghaka)… Other (specify) ………………………………………… Don't know…………………………………………………	1 2 3 4 5 6 7 8 9 10 11 12 13 98
89	Where does [NAME OF HELPER] live? ** …………..aviira gha?	Same house (munumba n'endala)…………… Same village (wa kukyaalo n'ekilala)……….. Different village (kukyalo eky'endhawulo).. Don't know…………………………………………………	1 2 3 98
90	What did [NAME OF HELPER] provide? ** (____________yakughaki?	Services like house help or child care (obuyambi nga okuyamba waka oba okulabirila omwana)……………………………… Transportation	1 2

		(eby'entambura)................ Things you need such as food, clothing, soap, etc (ebintuby'oyenda nga emere, engoye, sabuuni, n'ebindhi)........................ 3 Money (sente)... 4 Other (specify) .... 5 Don't know... 98	
91	In total, for how long has [NAME OF HELPER] been helping you/[HOUSEHOLD MEMBER]? **Mu kutwalilaaghalala.........amaze ibanga ki nga akuyamba/ (ow'omumaka)	__________ days (nnaku).................. 1 __________ weeks (wiki/sasira)....... 2 __________ months (myezi)............... 3 __________ years (myaka)................ 4 Don't know... 98	
92	During these...[AMOUNT OF TIME FROM QUESTION 91], how frequently did [NAME OF HELPER] help you/[NAME OF DECEASED HOUSEHOLD MEMBER] during this time? **Mu ibanga lino elye ....(katugeze nga wiki/sasiraibiri)....................(erii na) yakuyamba emirundi emeka?	_____ hours per day (mirundi......bulilunaku) 1 ______days per week (mirundi.....buli wiki/ sasira)... 2 ___days per month (mirundi.......buli mwezi) 3 Don't know... 98	
93	Did you/[HOUSEHOLD MEMBER] have to give [NAME of helper] payment (money or in-kind) for the help? **Ighe/(ow'omumaka)wali otekwa okusasulira obuyambi buno(musente oba mungeri ey'eyindi yona yona).	Yes.. 1	
		No...2	SKIP TO Q95
		Don't know... 98	
94	What payment did you/[HOUSEHOLD MEMBER] give?	In-kind, specify: (mubuntu bulungi) (inhonhola)______________________........... 1	

**Nsasula kika ki gye ghaghaayo?	Money, specify (shillings): (sent inhonhola (silinghi)________________……………. ……. 2 Don't know………………………………………… 9 8

EMPLOYMENT

Now I would like to ask you some questions about your employment before and after the injury.
**Buti nandhienze okubuuzaaku ebibuzo kumulimo gwo ng'okaali era ng'omaze okufunha obukosefu.

	QUESTIONS	RESPONSES		
95	**IF INJURED INDIVIDUAL IS ALIVE, ASK:** What was your/[HOUSEHOLD MEMBER'S] occupation before the injury? **Buti okola mulimu ki? **IF INJURED INDIVIDUAL IS DECEASED, ASK:** What was [NAME OF DECEASED HOUSEHOLD MEMBER]'s occupation before the injury? **_____________yali akola mulimo ki ng'akali kufuna bukosefu?	Shop/business (musubuzi)……………………	1	
		Bodaboda/taxi (wa boda boda oba takisi)……………………………………… …….	2	
		Professional (mulimo musomerere)…….	3	
		Farmer/agriculture (mulimi)……………….	4	
		Vendor (market, street, and vendor) atunda mu katale, mutembeeyi)…………	5	
		Laborer (wage) mupakasi ………………….	6	
		Mechanical work (makanika)………………	7	
		Construction (buzimbi)………………………	8	
		Student (musomi)…………………………….	9	
		Homemaker (mukozi wa waka)…………..	10	
		Unemployed (azira mulimo)……………….	11	
		Other (specify) ……………………………….	12	
		Pre-school child, not employed………….	13	SKIP TO Q101
		Don't know………………………………………	98	
96	**IF INJURED INDIVIDUAL IS ALIVE, ASK:** What is your/[HOUSEHOLDMEMBER'S]	Shop/business (musubuzi)……………………	1	
		Bodaboda/taxi	2	

	current occupation? **Wali okola mulimu 10in g'okali kufuna bukosefu? **IF INJURED INDIVIDUAL IS DECEASED, ASK:** What was [NAME OF DECEASED HOUSEHOLD MEMBER]'s occupation after the injury? **___________yali akola mulimo 10in g'akali kufuna bukosefu?	(bodaboda/takisi).......... Professional (mulimu musomerere)....... Farmer/agriculture (mulimi).................. Vendor (market, street, and vendor) atunda mu mukatale,mutembeeyi......... Laborer (wage) mupakasi........................ Mechanical work (makanika)................. Construction (buzimbi).........................	 3 4 5 6 7 8	
		Student (musomi).................................	9	**SKIP TO Q100**
		Homemaker (mukozi wa mumaka)......... Unemployed (azira mulimu).................. Other (specify) .... Don't know...	1 0 1 1 1 2 9 8	
97	Following your/[HOUSEHOLD MEMBER'S] injury, were you able to return to your previous occupation?**Ng' omaze okufunha obukosefu,wali osobola okwiirayo kumulimu gw'owali okola?	Yes..	1	**SKIP TO Q99**
		No..	2	
		Don't know....................................	9 8	
98	Did you/[HOUSEHOLD MEMBER] lose your/[HOUSEHOLD MEMBER'S] job because of your injury? **Wafiirwa omulimu gwo olw'obukosefu?	Yes...	1	**SKIP TO Q101**
		No.. .... Don't know...	2 9 8	
99	How many days of work did you/[HOUSEHOLD MEMBER] lose after the injury? **Wafiirwa ennaku imeka edh'okukola ng'omaze okufunha obukosefu?	____________________ Don't know....................................	 9 8	**SKIP TO Q101**
10	How many days of school did			

0	you/ [HOUSEHOLD MEMBER] lose after the injury? **Ennaku imeka edh'okusoma ighe (ow'omumaka) dhewa/yafirwa ng'omaze/amaze okufunha obukosefu?	______________________________ _ Don't know..................................... 98

COPING WITH THE INJURY FINANCIALLY

Now I would like to ask you some questions about how your household coped with the injury financially.

**Buti nandhienze okukubuzaaku ebibuzo kungeri amakaago gyegagumira obukosefu mubyenfuna.

QUESTION 101	RESPONSES		
	101A	101B	101C
As a result of the injury, was there a decrease in your household's… **Nga ekyaava kubukosefu,mumakaago mwalimuku enkendeera mu….	income (money coming in, not expenditure)?**enhingiza(sente edhiingira so ti edhifuruma)	food production? **emmere ekungulwa	food purchases? **emmere egulwa
	Yes.......................... 1 No.......................... 2	Yes.................... 1 No.................... 2 NA.................... 3	Yes.................... 1 No.................... 2 NA.................... 3

QUESTION 102	102A	102B	102C
How did your household cope with this injury financially? **Amakaago gasobola gatya okugumira obukosefu bwo mubyenfunha? **USE CODES BELOW**	1st most important coping method **Engeri esooka ey'okuguma	2nd most important coping method **Engeri ey'okbiri ey'okuguma	3rd most important coping method **Engeri ey'okusatu ey'okuguma

Codes for Columns 102A, 102B, and 102C:

1	Unconditional help provided by relatives/friends. **Obuyambi obuziraku bukwakulizo okuva mub'enghanda n'abemikwano)
2	Unconditional help provided by government. **Obuyambi obuziraku bukwakulizo okuva mu gavumenti
3	Changed dietary patterns involuntarily (relied on less preferred food options, reduced the proportion or number of meals per day, skipped days without eating, etc.). **Yakyuusa ebyendha nga tiyeyendheire (yyesigama ku mere etayendhebwa inho,yasala ku biwulo ebya buli lunaku, yamalanga ennaku nga talya,ebindhi.

4	Changed gardening/farming practices (crop choices or technology). **Yakyuusa mu nnima oba ensimba y'emmere.
5	Household member(s) took on more non-farm (wage- or self-) employment. **Owo/ab'omumaka bafunha emirimu egyindhi egyisasulwa nga tigya ku faamu.
6	Household member(s) took on more farm wage employment. **Owo/abomumaka bafunha emirimu egyindhi egy'oku faamu nga gisasulwa.
7	Household members left the household or people joined the household.(abomumaka baava mu maka oba abantu b'eyunga ku maka)
8	Relied on savings. **Besigama ku ntereke.
9	Got a loan. **Bafunha looni/bewola.
10	Sold durable household assets (agricultural or non-agricultural).**Batunda eby'omumaka gaibwe ebighangaazi (ebilimwa oba ebitalimwa).
11	Sold land/building. **Batunda eitaka/enhumba
12	Rented out land/building. **Bapangisa eitaka/ekizimbe
13	Sold animal stock. **Batunda ebyaayo
14	NA
15	Other (specify)

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EDUCATION AND TRAINING

PhD	Health Systems, International Health **Johns Hopkins Bloomberg School of Public Health,** **Johns Hopkins University**	2015
M.P.H.	Population and Family Health **Mailman School of Public Health, Columbia University**	2006
Certificate	Management of Service Programs **Institute for Not-For Profit Management** **Columbia Business School, Columbia University**	2003
B.A.	Neuroscience and Behavior **Columbia College, Columbia University**	2002

RESEARCH EXPERIENCE

Research Assistant June 2012 – January 2015
Johns Hopkins International Research Unit
Provided assistance with the development and implementation of a trauma, injury, and disability research capacity training program in Uganda. Helped develop, deliver, and evaluate Uganda-based workshops and Baltimore-based six week training programs. Assisted with the preparation of grant reports and wrote and published quarterly newsletters.

Associate in Research January 2007 – July 2010
Duke Global Health Institute, Duke University
Provided assistance with developing and implementing health systems research studies in low- and middle-income countries including India and Uganda. Wrote research reports and policy papers and assisted with journal papers. Provided technical and scientific advice to the Institute Director and faculty members. Assisted with the textbook revision of the third edition of *International Public Health.*

Intern June – November 2006
William J. Clinton Foundation Pediatric HIV/AIDS Initiative
Helped prepare a tool kit of training resources, articles, and ART guideline reports for field staff in partner countries. Assisted with designing monitoring and evaluation tools.

Aisha Jafri

Research Assistant January – August 2006
Averting Maternal Death and Disability,
Columbia University Mailman School of Public Health
Compiled and disseminated weekly literature reviews on emergency obstetric care in developing countries. Assisted with preparing manuscripts, workshops and presentations.

Intern January – October 2005
Columbia Presbyterian Ambulatory Care Network
Designed medical chart review tool, reviewed over 200 records of under-immunized children, analyzed data on registry completeness, and proposed recommendations to clinic directors for performance improvement in childhood immunization.

Research Assistant May – August 2005
Injury Free Coalition, Department of Epidemiology
Mailman School of Public Health, Columbia University
Collected and analyzed injury risk assessment data at a Seniors Injury Prevention Fair in Harlem. Assisted in preparation of grant proposals and manuscripts.

PUBLICATIONS

Thirumurthy H, Jafri A, Srinivas G, et al. Two-year impacts on employment and income among adults receiving antiretroviral therapy in Tamil Nadu, India: a cohort study. Aids. Jan 14 2011;25(2):239-246.

Pressley JC, Barlow B, Quitel L, Jafri A. Improving access to comprehensive injury risk assessment and risk factor reduction in older adult populations. Am J Public Health. April 2007;97(4):676-8.

PRESENTATIONS

Nafula, M., Jafri, A., Dossary, K., Burgess, S., Chitah, B., Gútierrez, J.P., Oanh, K.T., Onama, V., Weinhold, A., Schulman, K., Merson, M. (2009, May) *Health Systems Strengthening through Human Resources and Capacity Building: The Supply of Health Systems Management, Policy, and Financing Training Programs and the Demand for Health Systems Experts.* Talk presented to Human Resources for Health Results Research Symposium. Addis Ababa, Ethiopia.

Thirumurthy, H., Saravanan, R., Srinivas, G., Jafri, A., Sreevidya, J., Sahu, S. (2008, August) *The Impact of ART on Socioeconomic Outcomes of HIV-infected Adult Patients in the Tamil Nadu Family Care Continuum Program, India.* Talk presented to the XVII International AIDS Conference, Mexico City, Mexico.

Srinivas, G., Jeyaseelan, L., Vallinayaki, D., Jafri, A., Raghavan, S., Sahu, S. (2008, August) *Evaluation of Nutritional Supplementation among HIV-infected patients in the Tamil Nadu Family Care Continuum (TNFCC) Program in India.* Poster presented to the XVII International AIDS Conference, Mexico City, Mexico.

TEACHING EXPERIENCE

Teaching Assistant
Department of International Health,
Johns Hopkins Bloomberg School of Public Health, Johns Hopkins University

Summary Measures of Population Health 2011 – 2015
Prepared session materials, managed bulletin boards, held office hours, and helped design and grade assignments and exams for the on-site and online versions of the course.

Health Systems Program Seminar September to December 2013
Helped revamp the curriculum of seminar topics and provided assistance to guest faculty presenters.

Health Systems in Low- and Middle-Income Countries 2011 – 2012
Prepared session materials, and designed and graded assignments and exams.

Teaching Assistant
Global Health Capstone Seminar, Global Health Certificate Program,
Duke Global Health Institute, Duke University
Helped design curriculum, prepared session materials, and designed and graded assignments and exams.

Teaching Assistant
Quantitative Data Analysis: Service-Based Research II,
Population and Family Health, Mailman School of Public Health,
Columbia University
Led class exercises and labs, prepared course materials, held weekly office hours, and graded assignments.

Aisha Jafri

AWARDS

Robert & Helen Wright Award 2012

MANAGEMENT EXPERIENCE

Health Leads, New York City Site

Director 2002 – 2004
Managed five after-school and advocacy programs serving over 300 children and families annually. Developed and implemented evaluation tools. Oversaw volunteer leadership and cultivated collaborative relationships with Harlem Hospital Center and community-based organizations.

Campus Coordinator 2000 – 2001
Supervised 20 program coordinators and helped them develop and execute program plans. Led bi-weekly staff meetings and annual retreats.

Program Coordinator 1999 - 2000
Provided weekly peer group activities and academic support for HIV-infected and -affected adolescents. Trained and supervised a team of ten youth workers.

OTHER EXPERIENCE

Black and Latino Student Caucus International Trip Participant 2005
Rakai Health Sciences Project, Johns Hopkins Bloomberg School of Public Health and Makerere University School of Public Health
Shadowed data collection and analysis teams, specifically for the randomized trial of male circumcision in Kalisizo, Uganda. Studied HIV prevention projects and research.

ADDITIONAL INFORMATION

Computer literate (Microsoft Word, Access, Excel, PowerPoint, Endnote, SPSS, STATA, and Epi Info). Basic Spanish.